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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

1918.

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Errata.

Vol. for 1917, p. 342, line 13 from top, *add* 17.62 after bodies.

Page 149, line 13 from top, add 6. *laxiflora* after longa.
Page 167, line 6 from top, for *sphaeroi*, read *sphaeroideum*.
Page 208, lines 11 and 12 from bottom have been transposed.

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BULLETIN

OF

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APPENDIX I.—1918.

LIST OF SEEDS OF HARDY HERBACEOUS PLANTS AND OF TREES AND SHRUBS.

The following is a select list of seeds of Hardy Herbaceous Plants and of Hardy Trees and Shrubs which, for the most part, have ripened at Kew during the year 1917. These seeds are available only for exchange with Botanic Gardens, as well as with regular correspondents of Kew. No application, except from remote colonial possessions, can be entertained after the end of February.

HERBACEOUS PLANTS.

Abronia arenaria.

Acaena glaucophylla.
macrostemon.
microphylla.
myriophylla.
Novae-Zelandiae.

Achillea ageratifolia.
argentea.
Clavennae.
Gerberi.
Kellereri.
tomentosa.
Wilczekii.

Aciphylla Colensoi.

Aconitum barbatum.
gymnandrum.
Kusnezoffi.
leptanthum.
Lycoctonum.
luridum.
moldavicum.
uncinatum.
Wilsoni.

Actaea alba.
arguta.

Adenophora liliifolia.
ornata.
stylosa.

Adonis amurensis.

(5134.) Wt. 152—669. 1,125. 12/17. J. T. & S., Ltd. G. 14. Sch. 12.

Aethionema cappadocicum.
cordatum.
pulchellum.
saxatile.

Agrostis alba.

Allium atropurpureum.
grande.
kansuense.
karataviense.
macranthum.
neapolitanum.
odorum.
polyphyllum.
pulchellum.
Schuberti.
scorzonerifolium.
subhirsutum.
Tubergeni.

Alonsoa Warscewiczii.

Alstroemeria aurantiaca.
Ligtu.

Althaea armeniaca.
cannabina.
ficifolia.
kurdica.
pallida.
rosea.

Alyssum amanum.
creticum.
incanum.
podolicum.
saxatile.
serpyllifolium.
sinuatum.
spinosum.

Amarantus caudatus.
chlorostachys.
hypochondriacus.
polygamus.
retroflexus.

Amethystea coerulea.

Ammobium alatum.

Anacyclus officinarum.

Androsace albana.
coccinea.
lactiflora.
lanuginosa.
primuloides.
villosa.

Anemone alpina.
decapetala.
multifida.
pratense.
Pulsatilla.
rivularis.
sulphurea.
sylvestris.
vitifolia.

Anthemis macedonica.
montana.
tinctoria.

Anthericum Liliago.
ramosum.

Antirrhinum hispanicum.
Orontium.

Apera Spica-Venti.

Aplopappus croceus.

Aquilegia canadensis.
chrysantha.
coerulea.
flabellata.
glandulosa.
pyrenaica.
truncata.

Arabis arenosa.
bellidifolia.
verna.

Arctotis stoechadifolia.

Arenaria cephalotes.
foliosa.
glandulifera.
gypsophiloides.
grandiflora.
montana.
pinifolia.
purpurascens.
sajanensis.

Argemone alba.
mexicana.

Armeria canescens.
chilensis.
fasciculata.
majellensis.

Arnica latifolia.
longifolia.
sachalinensis.

Asperula azurea.
galioides.

Asphodeline lutea.

Asphodelus albus.

Aster alpinus.
Douglasii.
fuscescens.
himalaicus.
lichiangensis.
Lipskyi.
oreophilus.
sericeus.
subcceruleus.
vestitus.

Astilbe chinensis.
rivularis.
Thunbergii.

Astragalus arcticus.
chinensis.
frigidus.
Glyciphyllos.
maximus.
pentaglottis.
stipulatus.
xiphocarpus.

Astrantia helleborifolia.

Athamanta Matthioli.

Atriplex rosea.

Atropa Belladonna.
lutescens.

Barbarea arcuata.

Beckmannia erucaeformis.

Berkheya purpurea.

Biscutella ciliata.
didyma.
laevigata.

Bocconia cordata.

Brachypodium caespitosum.
japonicum.

Brassica campestris.
Erucastrum.
juncea.
napus var. dichotoma.
rugosa.
Tourneforti.

Brickellia grandiflora.

Briza maxima.
minor.

Bromus ciliatus.
japonicus.
maximus.
rubens.
squarrosus.
unioloides.

Bulbinella Hookeri.

Buphthalmum salicifolium.

Bupleurum Candollei.
longifolium.
sachalinense.

Cakile maritima.

Calamagrostis Epigeios.

Calandrinia speciosa.

Callirhoë involucrata.
pedata.

Callistephus hortensis.

Camassia Fraseri.
Leichtlinii.
montana.

Camelina sativa.

Campanula barbata.
bononiensis.
Cervicaria.
Imeretina.
Kolenatiana.
lactiflora.
lanata.
latifolia.
latiloba.
longistyla.
macrostyla.
patula.
phyctidocalyx.
pulla.
rhomboidalis.
Scheuchzeri.
serotina.
speciosa.
thyrsoides × spicata.

Capsella grandiflora.

Carbenia benedicta.

Carduus tenuiflorus.

Carex binervis.
laevigata.

Carum copticum.

Catananche coerulea.
lutea.

Cathcartia villosa.

Centaurea axillaris.
dealbata.
montana.
Phrygia.
rupestris.

Centranthus Sibthorpii.

Cephalaria radiata.

Cerastium Biebersteinii.
macranthum.
tomentosum.

Chaerophyllum aromaticum.
nodosum.

Charieis heterophylla.

Chelone Lyoni.
obliqua.

Chenopodium ambrosoides.
capitatum.
urbicum.

Chlorogalum pomeridianum.

Chorispora tenella.

Chrysanthemum carinatum.
caucasicum.
cinerariaefolium.
coronarium.
corymbosum.
Haussknechtii.
pallens.

Clarkia elegans.
pulchella.

Cnicus Eriophorum.
syriacus.

Collinsia bicolor.

Convolvulus undulatus.

Coriandrum sativum.

Coronilla minima.

Corydalis capnoides.
lutea.

Cosmidium Burridgeanum.

Craspedia alpina.

Crepis aurea.
blattarioides.
grandiflora.
pygmaea.
rubra.

Crocus asturicus.
medius.

Crucianella aegyptiaca.

Cynoglossum coelestinum.
nervosum.
Wallichii.

Dactylis altaica.

Dahlia variabilis.

Delphinium aconiti.
caucasicum.
decorum.
Delavayi.
elatum.
Geyeri.
grandiflorum.
Maackianum.
Menziesii.
occidentale.
pictum.
speciosum.
— var. glabratum.
vestitum.

Deschampsia caespitosa.
tenella.

Deyeuxia Langsdorfii.

Dianthus arenarius.
Armeria.
caesius.
capitatus.
Caryophyllus.
cruentus.
deltoides.
fragrans.
frigidus.
gallicus.
giganteus.
leptopetalus.
neglectus.
pallidiflorus.
petraeus.
Seguieri.
squarrosus.
subacaulis.
superbus.
viscidus.
Waldsteinii.

Dictamnus albus.

Digitalis ambigua.

Dimorphotheca hybrida.
pluvialis.

Dodecatheon frigidum.
Meadia.

Draba aizoides.
Bertolonii.
carinthiaca.
fladnizensis.
frigida.
incana.
nivalis.
rigida.
Salomonii.
surculosa.

Dracocephalum Moldavica.
nutans.
parviflorum.

Dryas Drummondii.
lanata.

Encelia calva.

Epilobium crassum.
Dodonaei.
luteum.

Epipactis palustris.

Eragrostis abyssinica.

Eranthis cilicica.

Eremostachys laciniata.

Eremurus himalaicus.
robustus.

Erigeron alpinus.
aurantiacus.
glabellus.
grandiflorus.
multiradiatus.
salsuginosus.
uniflorus.

Erinus alpinus.

Erodium amanum.
Botrys.
macradenum.
Manescavii.
supracanum.
trichomanefolium.

Eryngium alpinum.

Erysimum rupestre.

Erythronium californicum.
revolutum.

Eschscholzia caespitosa.
californica.
Douglasii.

Eucharidium Breweri.
concinnum.

Festuca heterophylla.
Myuros.
rigida.
vaginata.

Fragaria indica.

Francoa appendiculata.
ramosa.

Fritillaria citrina.

Galactites tomentosa.

Galega orientalis.
patula.

Galeopsis Tetrahit.

Galium thymifolium.

Gastridium australe.

Gauidinia fragilis.

Gentiana asclepiadea.
crassicaulis.
Cruciata.
dahurica.
decumbens.
Elwesiana.
Freyniana.
lutea.
macrophylla.
phlogifolia.
septemfida.
straminea.
stylophora.
tibetica.

Geranium albiflorum.
Fremonti.
grandiflorum.
ibericum.
incisum.
rivulare.
sessiliflorum.
tuberosum.

Gerbera Anandria.

Geum bulgaricum.
chiloense.
Heldreichii.
montanum.
Rossii.
triflorum.

Gilia achilleaefolia.
androsacea.
capitata.
densiflora.
micrantha.
multicaulis.
squarrosa.
tricolor.

Gillenia trifoliata.

Glaucium corniculatum.
flavum var. tricolor.

Globularia cordifolia.
vulgaris.

Glyceria distans.

Grindelia cuneifolia.
robusta.

Guizotia oleifera.

Gypsophila elegans.
Steveni.

Halenia elliptica.

Hastingsia alba.

Hedysarum esculentum.
flavescens.
Semenovii.

Helenium Bigelovii.
Hoopesii.
tenuifolium.

Helianthemum canum.

Helianthus Nuttallii.
occidentalis.

Helichrysum bracteatum.

Helipterum roseum.

Heracleum persicum.
pyrenaicum.

Herbertia pulchella.

Hesperis matronalis.

Heuchera Drummondi.

Hibiscus Trionum.

Hieracium alpinum.
Bornmülleri.
cappadocicum.
Heldreichii.
Jankae.
villosum.

Hilaria rigida.

Hordeum bulbosum.
maritimum.

Horminum pyrenaicum.

Hymenophysa pubescens.

Hyoscyamus albus.
muticus.

Hypecoum grandiflorum.
procumbens.

Hypericum Coris.
linarifolium.
nummularium.
olympicum.

Hypochaeris glabra.

Iberis Amara.
Lagascana.

Impatiens scabrida.

Inula ensifolia.
Hookeri.
macrocephala.
orientalis.
racemosa.
Royleana.

Iris Bulleyana.
Clarkei.
dichotoma.
Forrestii.
laevigata.
longipetala.
setosa.

Isatis glauca.

Jasione perennis.

Juncus alpinus.
Chamissonis.

Jurinia cyanoides.

Kitaibelia vitifolia.

Kniphofia citrina.

Kochia trichophila.

Koeleria phleoides.
splendens.

Lactuca perennis.

Lagurus ovatus.

Lallemantia canescens.

Lathyrus angulatus.
Aphaca.
cirrhosus.
laxiflorus.
luteus.
maritimus.
Nissolia.
Ochrus.
pisiformis.
polyanthus.
rotundifolius.
setifolius.
tingitanus.
tuberosus.
undulatus.
variegatus.
venosus.

Laurentia tenella.

Lavatera cachemiriana.

Leontopodium alpinum.

Leptosyne Douglasii.
maritima.
Stillmanni.

Leuzea conifera.
longifolia.

Ligusticum alatum.
pyrenaicum.
scoticum.

Limnanthes alba.

Linaria aparinoides.
bipartita.
maroccana.
multipunctata.
saxatilis.
triphylla.
tristis.
viscida.

Linum nervosum.
usitatissimum.

Lotus Requienii.
Tetragonolobus.

Lunaria annua.

Lupinus concinnus.
micranthus.
mutabilis.
nanus.
pubescens.

Luzula Hosti.
nivea.

Lychnis Delavayi.
Flos-jovis.
fulgens.
Haageana.
Lagascae.
Preslii.
Sartori.

Lycurus phleoides.

Malope trifida.

Malva Alcea.
oxyloba.
parviflora.

Meconopsis aculeata.
cambrica.
heterophylla.
paniculata.
Prattii.
simplicifolia.
Wallichii.

Medicago Murex.
orbicularis.
turbinata.

Melica altissima.
ciliata.

Mirabilis divaricata.
Jalapa.

Monolepis trifida.

Muscari armeniacum.
compactum.
neglectum.
paradoxum.
parviflorum.
pulchellum.

Myosurus minimus.

Myriactis Gmelini.

Nardus stricta.

Nemesia floribunda.

Nicandra physaloides.

Nicotiana affinis.
paniculata.
rustica.
Sanderae.
Tabacum.

Nigella corniculata.
damascena.
hispanica.

Noccaea alpina.

Oenothera amoena.
densiflora.
rosea.
tenella.
triloba.

Ornithogalum narbonense.

Oxytropis baicalensis.
ochroleuca.
pilosa.

Paeonia Brownii.
Emodi.
paradoxa.
peregrina.
Veitchii.

Panicum capillare.

Papaver alpinum.
Argemone.
commutatum.
glaucum.
laevigatum.
lateritium.
orientale.
pavoninum.
rupifragum.
somniferum.

Paradisia Liliastrum.

Patrinia heterophylla.
palmata.

Pentstemon acuminatus.
arizonicus.
barbatus.
campanulatus.
confertus.
deustus.
diffusus.
glaucus.
gracilis.
heterophyllus.
humilis.
isophyllus.
Jamesii.
Lobbi.
Menziesii var. Scouleri.
ovatus.
secundiflorus.

Perezia multiflora.

Petunia nyctaginiflora.

Phleum arenarium.
asperum.
Michelii.

Phlomis pratensis.
tuberosa.
umbrosa.

Physalis Alkekengi.
Bunyardi.
Francheti.

Physochlaina orientalis.

Physospermum cornubiense.

Physostegia virginiana.

Phyteuma Michelii.
orbiculare.
Scheuchzeri.
spicatum.

Phytolacca acinosa.
decandra.

Plantago Candollei.
Coronopus.
Cynops.
maritima.
Myosurus.
Psyllium.

Platycodon grandiflorum.
— var. Mariesii.

Platystemon californicus.

Pleurospermum Golaka.

Poa caesia.
violacea.

Podophyllum Emodi.

Polemonium mexicanum.
pauciflorum.

Polygonum affine.
viviparum.

Polypogon littoralis.
monspeliensis.

Portulaca grandiflora.

Potentilla argyrophylla.
calycina.
crinita.
dealbata.
glandulosa.
gracilis.
Herbichii.
Meyeri.
montenegrina.
multifida.
nepalensis.
nevadensis.
pennsylvanica.
recta.
rivale.
rupestris.
semilaciniata.
sericea.
tanacetifolia.

Pratia angulata.

Prenanthes altissima.

Preslia cervina.

Primula Beesiana.
Bulleyana.
capitata.
Cockburniana.
frondosa.
Giraldiana.
involucrata.
Littoniana.
pseudo-sikkimensis
pulverulenta.
rosea.
saxatilis.
Smithiana.

Psoralea acaulis.
macrostachya.
physodes.

Ramondia pyrenaica.

Ranunculus chaerophyllus.
Nyssanus.

Reseda virgata.

Rhagadiolus edulis.

Rheum acuminatum.
nobile.
Ribes.

Rodgersia aesculifolia.
pinnata.
podophylla.
sambucifolia.

Roemeria hybrida.

Romulea candida.
speciosa.

Rudbeckia ampla.
amplexicaulis.
speciosa.
subtomentosa.

Rumex maximus.
sanguineus.

Salvia argentea.
Bertolonii.
glutinosa.
Horminum.
Sclarea.
uliginosa.
verticillata.
virgata.

Saponaria Vaccaria.

Saussurea albescens.
hypoleuca.
salicifolia.

Saxifraga canaliculata.
cartilaginea.
cochlearis.
— var. minor.
cordigera.
decipiens.
Delavayi.
granulata.
Hausmanni.

Saxifraga—*cont.*
Hirculus.
lingulata.
— var. lantoscana.
longifolia.
manshuriensis.
montavoniensis.
mutata.
pedemontana.
rotundifolia.

Scabiosa caucasica var. connata.
graminifolia.
gramuntia.
Kitaibelii.
longifolia.
vestina.

Scilla autumnalis.
verna.

Scopolia lurida.
sinesis.

Scrophularia nodosa.
Scorodonia.

Sedum altissimum.
Ewersii.
heterodontum.
kamtschaticum.
maximum.
rhodanthum.
spathulifolium.
ternatum.

Selinum serbicum.
vaginatum.

Senecio abrotanifolium.
adonidifolium.
alpinus.
Clivorum.
Doronicum.
elegans.
Ledebouri.
Ligularia.
Lyallii.
squalidus.
stenocephalus.

Serratula atriplicifolia.
Gmelinii.
quinquefolia.
tinctoria.

Seseli elatum.
glaucum.

Setaria glauca.
italica.

Sidalcea candida.
Listeri.
malvaeflora.
neo-mexicana.

Siderites scordiodes.

Siegesbeckia orientalis.

Silene alpestris.
asterias.
cretica.
fimbriata.
italica.
linicola.
longicilia.
melandrioides.
Muscipula.
noctiflora.
nocturna.
paradoxa.
pendula.
quadrifida.
Reichenbachii.
rupestris.
squamigera.
tenuis.
vallesia.
verecunda.
Zawadskii.

Silybum eburneum.
Marianum.

Sisymbrium strictissimum.

Smyrnium Olusatrum.

Specularia pentagonia.
perfoliata.
Speculum.

Spiraea digitata.
palmata.

Stachys Alopecuros.
citrina.
graeca.
grandiflora.

Statice bellidifolia.
latifolia.
tatarica.

Stipa Calamagrostis.
papposa.
pennata.

Swertia longifolia.
perennis.

Symphyandra Hofmanni.
Wanneri.

Tellima grandiflora.

Thalictrum aquilegifolium.
corynellum.
cultratum.
squarrosum.

Thermopsis fabacea.
lanceolata.

Thymus odoratissimus.

Trautvetteria palmata.

Trifolium elegans.
Lupinaster.
ochroleucum.
pannonicum.

Trigonella coerulea.
corniculata.
cretica.
polycerata.
radiata.

Trillium grandiflorum.

Trollius altaicus.
asiaticus.
sinensis.

Troximon grandiflorum.

Tulipa Batalini.
chrysantha.
dasystemon.
Kaufmanniana.
linifolia.
Sprengeri.

Ursinia pulchra.

Urtica pilulifera.

Valerianella carinata.
dentata.
echinata.
eriocarpa.
vesicaria.

Verbascum olympicum.
phoeniceum.

Verbena bonariensis.
erinoides.

Verbesina helianthoides.
Purpusii.

Veronica austriaca.
gentianoides.
incana.
saxatilis.
spicata.
virginica.
— var. japonica.

Vesicaria utriculata.

Vicia angustifolia.
calcarata.
melanops.
unijuga.

Vincetoxicum fuscatum.

Viola cornuta.
persicifolia.

Xanthocephalum gymnospermoides.

Zygadenus elegans.

TREES AND SHRUBS.

Those marked with an asterisk were not grown at Kew.

*Abies Mariesii.
*sachalinensis.
*— var. nemorensis.
*umbellata.
*Veitchii var. olivacea.

Acanthopanax divaricatum.
sessiliflorum.
setchuenensis

Acer circinatum.
dasycarpum.
glabrum.
hyrcanum.
insigne.
Lobelii.
macrophyllum.
micranthum.
monspessulanum.
neglectum.
opulifolium.
tataricum.
tetramerum.
Trautvetteri.
Tschonoskii.

Actinidia arguta.

Aesculus indica.

Alnus barbata.
cordifolia.
elliptica.
firma.
incana.
japonica.
oregona.
orientalis.
serrulata.
sitchensis.
Spaethii.
tenuifolia.
viridis.

Amelanchier asiatica.
vulgaris.

*Amorpha canescens.
Andrachne colchica.

Aralia chinensis.
— var. pyramidalis.

Arctostaphylos tomentosa.

*Ardisia crispa.

Asimina triloba.

Berberis aggregrata.
angulosa.
Aquifolium.
aristata.
Beaniana.
canadensis.
Chitria.
concinna.
consimilis.
Darwinii.
diaphana.
dictyophylla.
dubia.
Edgeworthiana.
Gagnepainii.
Guimpelii.
Hookeri.
*integerrima.
japonica var. Bealei.
Lycium.
orthobotrys.
polyantha.
Prattii.
sinensis.
Stapfiana.
subcaulialata.
Thunbergii.
Tischleri.
umbellata.
virescens.
Wilsonae.
yunnanense.

Betula coerulea.
*cylindrostachya.
Ermani.
— var. nipponica.
fruticosa.
humilis.
japonica var. szechuanica.
kenaica.
lenta.
Medwediewii.
occidentalis.
papyrifera.
populifolia.
pumila.
utilis.
— var. Jacquemontii.

Bruckenthalia spiculifolia.

Buddleia albiflora.
Colvilei.
japonica.
nivea.
variabilis.
— var. Veitchiana.

Callicarpa Giraldiana.
japonica.

Calycanthus occidentalis.

Caragana ambigua.
arborescens.
— var. Redowskii.
aurantiaca.
Boisii.
decorticans.
frutescens.
microphylla.

Carmichaelia australis.
flagelliformis.

Carpinus caroliniana.
*cordata.
orientalis.
polyneura.

Cassinia fulvida.
Vauvilliersii.

Ceanothus americanus.
integerrimus.
papillosus.
thyrsiflorus.

Celastrus articulatus.
flagellaris.
scandens.

Celtis glabrata.
occidentalis.
Vilmoriniana.

Cephalotaxus drupacea.
Fortuni.
pedunculata.

*Cercis occidentalis.
Siliquastrum.

Chionanthus virginica.

Cistus albidus.
creticus.
crispus.
hirsutus.
*incanus.
laurifolius.
platysepalus.
populifolius.
salvifolius.
tauricus.
vaginatus.

Cladothamnus pyrolaeflorus.

Cladrastis amurensis.
— var. Buergeri.

Clematis aethusifolia var.
latisecta.
akebioides.
alpina.
connata.
— var. velutina.
Fargesii.
fusca.
grata.
heracleaefolia.
integrifolia.
ligusticifolia.
mandshurica.
montana.

Clematis—*cont.*
— var. rubens.
orientalis.
Pitcheri.
Rehderiana.
*Stanleyi (tender).
tangutica.
Veitchiana.
virginiana.

Clerodendron Fargesii.
trichotomum.

Clethra alnifolia.
*canescens.

Colutea.
bullata.
longialata.
media.

*Convolvulus scoparius.

Cornus alba.
Amomum.
Bretschneideri.
candidissima.
circinata.
controversa.
glabrata.
macrophylla.
Mas.
officinalis.
pubescens.
Purpusi.
sanguinea.
stolonifera.

Cotoneaster acutifolia.
— var. villosula.
affinis.
amoena.
apiculata.
applanata.
bacillaris.
— var. obtusata.
bullata.
buxifolia.
divaricata.
Fontanesii.
foveolata.
Franchetii.
frigida.

Cotoneaster—*cont.*
Harroviana.
Henryana.
horizontalis.
hupehensis.
laxiflora.
Lindleyi.
lucida.
microphylla.
moupinensis.
multiflora.
nitens.
Nummularia.
obscura.
pannosa.
pekinensis.
*racemiflora var. songorica.
rotundifolia.
salicifolia var. floccosa.
— var. rugosa.
Simonsii.
thymifolia.
tomentosa.
uniflora.
Zabelii.

Crataegus altaica.
Boyntonii.
Buckleyi.
Carrierei.
cordata.
cuneata.
foetida.
georgiana.
glandulosa.
infera.
intricata.
Lambertiana.
Macauleyi.
macracantha.
melanocarpa.
mollis.
pallens.
Peckii.
praecox.
pubescens var. stipulacea.
semi-orbiculata.
succulenta.
tanacetifolia.
torva.
verecunda.
Wheeleri.

Cupressus Benthami var. arizonica.
glabra.
Goveniana.
Lawsoniana.
macrocarpa.
nootkatensis.
obtusa.
pisifera.
thyoides.
torulosa.

Cytisus albus.
biflorus.
capitatus.
glabrescens.
Heuffeli.
horniflorus.
nigricans.
— var. Carlieri.
*pallidus.
*proliferus var. palmensis (tender).
purgans.
purpureus.
Rochelii.
scoparius.
— var. Andreanus.
sessilifolius.
*stenopetalus (tender).

Daboëcia polifolia.

Daphne Mezereum.
— var. alba.

Daphniphyllum macropodum.

Desmodium cinerascens.
tiliaefolium.

Deutzia corymbosa.
crenata.
discolor var. major.
— var. purpurascens.
globosa.
longifolia.
— var. Veitchii.
macrocephala.
planifolia.
reflexa.
Sieboldiana.
Vilmoriniae.
Wilsonii.

Diervilla Lonicera.
rivularis.
sessilifolia.

Diospyros Lotus.
— var. sylvestris.
virginiana.

Distylium racemosum.

*Dracaena Draco (tender).

*Echium candicans (tender).
simplex (tender).

Elaeagnus argentea.
multiflora.
umbellata.

Eleutherococcus Henryi.
leucorrhizus.
— var. fulvescens.
scaberulus.
Simonii.

Elsholtzia Stauntoni.

Enkianthus campanulatus.
japonicus.

Erica arborea.
— var. alpina.
cinerea.
lusitanica.
Mackaii.
scoparia.
stricta.
Tetralix.

*Eucalyptus coccifera.
*MacArthuri.

Euonymus Hamiltonianus.
latifolius.
oxyphyllus.
planipes.
ussuriensis.
verrucosus.
yedoensis.

Evodia hupehensis.

Exochorda Albertii.
grandiflora.
— var. Wilsonii.

Fraxinus coriacea.
Mariesii.
oregona.
Ornus.
parvifolia.
pennsylvanica.

Garrya elliptica.

Gaultheria procumbens.
pyroloides var. cuneata.
Shallon.

Gaylussacia dumosa.

Genista aethnensis.
germanica.
pilosa.
radiata.
tinctoria.
— var. elatior.
virgata.

Halesia hispida.
tetraptera.

Hamamelis arborea.
— var. Zuccariniana.

Helianthemum alyssoides.
polifolium.
Tuberaria.
villosum.

Hydrangea aspera.
Bretschneideri.
canescens.
paniculata.
petiolaris.
radiata.
vestita.
xanthoneura.
— var. glabrescens.
— var. Wilsonii.

Hypericum Androsaemum.
aureum.
elatum.
galioides.
Hookérianum.
inodorum.
Kalmianum.
patulum.
— var. Henryi.
perforatum
prolificum.

Ilex opaca.
Pernyi.
Sieboldii.
verticillata.

Indigofera Gerardiana.

Jamesia americana.

Jasminum fruticans.
humile.

*Juniperus communis
*Lobelii.
*maritima.
*Oxycedrus.
*rufescens.
*thurifera.

Kalmia cuneata.
glauca.
latifolia.
— var. myrtifolia.

*Larix dahurica var. japonica.

Laurus nobilis var. angustifolia.

Ledum latifolium.
palustre.

Leucothöe racemosa.

Leycesteria formosa.

Ligustrum Delavayanum.
Ibota.
insulare.
medium.
Prattii.
yunnanense.

Lomatea ferruginea.

Lonicera alpigena.
chaetocarpa.
chrysantha.
coerulescens.
conjugalis.
deflexicalyx.
depressa.
dioica.
Ferdinandii.
floribunda.
gynochlamydea.
Henryi.
iberica.
involucrata.
— var. Ledebourii.
Kesselringii.
Maackii.
micrantha.
minutiflora.
Morrowi.
nigra.
obovata.
orientalis.
ovalis.
pileata.
prostrata.
segreziensis.
syringantha.
Sullivantii.
tatarica.
translucens.
trichosantha.
Xylosteum.

Lupinus arboreus.

Lycium pallidum.

Lyonia ligustrina.

Magnolia Lennei.
Soulangeana.
tripetala.

Meliosma cuneifolia.

Menispermum canadense.

Menziesia globularis.

Microglossa albescens.

*Morus acidosa.

Myricaria germanica.

Neillia amurensis.
capitata.
opulifolia.
Ramuleyi.
Torreyi.

Nesaea salicifolia.

Notospartium Carmichaeliae.

Nuttallia cerasiformis.

Nyssa sylvatica.

Olearia Haastii.
myrsinoides.

Ononis fruticosa.
rotundifolia.

*Ostrya japonica.

Paliurus australis.

Peraphyllum ramossimum.

Pernettya mucronata.

Pertya sinensis.

Petteria ramentacea.

Phellodendron amurense.
chinense.
sachalinense.

Philadelphus acuminatus.
brachybotrys.
— var. purpurascens.
californicus.
columbianus.
Gordonianus.
inodorus.
latifolius.
Lewisii.
Magdalenae.
sericanthus.
tomentosus.
Wilsonii.

Phillyraea angustifolia.

*Picea Glehnii.
*Koyamai.

Picrasma ailanthoides.

Pieris formosa.
japonica.
mariana.

*Pinus canariensis (tender).
*halepensis.
*luchuensis (tender).

*Pittosporum Ralphii.

Platanus acerifolia.
orientalis.

Prunus acida var. semperflorens.
cornuta.
divaricata.
incana.
japonica.
maritima.
*pennsylvanica.
— var. saximontana.
pumila.
serotina var. salicifolia.

Pseudolarix Fortunei.

Ptelea isophylla.
trifoliata.

*Pueraria Thunbergiana.

Pyracantha angustifolia.
coccinea.
crenulata.
— var. Rogersiana.
Gibbsii.

Pyrus alnifolia.
alpina.
americana.
arbutifolia.
auricularis.
crataegifolia.
decurrens.
Folgneri.
Hostii.
hybrida.
kansuense.
Keissleri.
lobata.
Meinichii.
minima.
nigra.
pekinensis.
pinnatifida.
Prattii.
rivularis.
rotundifolia.
salicifolia.
sambucifolia.
Sargentii.
scalaris.
setschwanensis.
sikkimensis.
sorbifolia.
Sorbus.
Toringo.
Torminalis.
Vilmorinii.
yunnanensis.
Zahlbruckneri.
Zumi.

Quercus castanaefolia.
coccifera.
fulhamensis.
lanuginosa.
Libani.
macedonica.
Mirbeckii.
occidentalis.
rubra.

Raphiolepis japonica.

Rhamnus Alaternus.
cathartica.
davurica.
fallax.
Frangula.
japonica.
mandshurica.
utilis.

Rhododendron ambiguum.
brachycarpum.
californicum.
concinnum.
decorum.
discolor.
ferrugineum.
Fortunei.
halense.
hirsutum.
lepidotum.
maximum.
Metternichii.
— var. angustifolium.
micranthum.
oreotrephes.
polylepis.
punctatum.
*quinquefolium var. album.
racemosum.
rhombicum.
rubiginosum.
*semibarbatum.
siderophyllum.
Smirnowi.
Vaseyi.
viscosum.
yanthinum.
yunnanense.

Rhodotypos kerrioides.

Ribes alpinum.
cereum.
cruentum.
divaricatum.
holosericeum.
mandshuricum.
petraeum.
robustum.
rotundifolium.
stenocarpum.
Warscewiczii.

Robinia Kelseyi.
neo-mexicana.

Rosa alpina.
coruscans.
Davidii.
elegantula.
glutinosa.
gymnocarpa.
Helenae.
Hugonis.
lucens.
Luciae.
macrophylla.
microphylla.
Moyesii.
omiensis.
— var. pteracantha.
pisocarpa.
rubrifolia.
Seraphinii.
sericea.
sertata.
setipoda.
sicula.
Soulieana.
spinulifolia.
Sweginzowii.
Webbiana.
Willmottiae.
Woodsii.

Rubus adenophorus.
biflorus var. quinqueflorus.
canadensis.
coreanus.
flosculosus.
Giraldianus.
illecebrosus.
inopertus.
lasiostylus.
— var. dizygos.
mesogaeus.
nigro-baccus.
nutkanus.
occidentalis.
odoratus.
omiensis.
parvifolius.
phoenicolasius.
Swinhoei.
thibetanus.
Thunbergi var. glabellus.

Rubus—*cont.*
trianthus.
Veitchii.
xanthocarpus.

Ruta graveolens.

Schizandra chinensis.

Schizophragma hydrangeoides.
integrifolia.

Securinega fluggeoides.
ramiflora.

*Sequoia gigantea.

Skimmia japonica.
Laureola.

Sophora flavescens.
viciifolia.

Spartium junceum.

Spiraea Aitchisoni.
arborea.
— var. glabrata.
arcuata.
bella.
betulifolia.
bracteata.
canescens.
chamaedrifolia.
discolor.
— var. dumosa.
japonica.
— var. ovalifolia.
laevigata.
Lindleyi.
longigemmis.
Nobleana.
nudiflora.
Rosthornii.
salicifolia.
Sargentiana.
sorbifolia.
— var. stellipila.
tomentosa.
Veitchii.
vestita.
Wilsonii.

Staphylea colchica.
Coulombieri.
pinnata.
trifolia.

Stewartia pentagyna.
Pseudo-camellia.

Stranviesia Davidiana.
— var. undulata.

Styrax japonicum.
Obássia.

Symphoricarpus Heyeri.

Syringa albo-rosea.
Emodi.
japonica.
Josikaea.
Julianae.
pekinensis.
villosa.
Wilsonii.

Taxus cuspidata.

*Tecoma Reginæ.

Thuya japonica.
orientalis.
plicata.

Trochodendron aralioides.

Vaccinium arboreum.
corymbosum.
hirsutum.
Mortinia.
neglectum.
pallidum.

*Viburnum acerifolium.
americanum.
betulifolium.
brevipes.
burejaeticum.
Canbyi.
cotinifolium.

Viburnum—*cont.*
hupehense.
ichangense.
Lantana.
lobophyllum.
ovatifolium.
*pauciflorum.
phlebotrichum.
pubescens.
rhytidophyllum.
Veitchii.
venosum.

Wistaria chinensis.
floribunda.
multijuga.

Xanthoceras sorbifolia.

*Yucca filamentosa.

Zanthoxylum Bungei.

Zenobia speciosa.
— var. pulverulenta.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

APPENDIX II.—1918.

LIST of STAFFS of the ROYAL BOTANIC GARDENS, Kew, and of Botanical Departments, Establishments and Officers at Home, and in India and the Colonies, in Correspondence with Kew.

* Trained at Kew. † Recommended by Kew.

Royal Botanic Gardens, Kew.—

Director	Lieut.-Col. Sir David Prain, I.M.S., C.M.G., C.I.E., M.A., M.B., LL.D., F.R.S., F.L.S.
Assistant Director	Arthur W. Hill, M.A., F.L.S.
Assistant, First Class	*John Aikman.
" " "	*William Nicholls Winn.
Keeper of Herbarium and Library	Otto Stapf, Ph.D., F.R.S. F.L.S.
Assistant, First Class	Charles Henry Wright, A.L.S.
" " "	*Robert Allen Rolfe, A.L.S.
" " "	*Sidney Alfred Skan.
" Second Class	Thomas Archibald Sprague, B.Sc., F.L.S.
" " "	Elsie Maud Wakefield, F.L.S.
" " "	*William Bertram Turrill, B.Sc.
" for India	*John Hutchinson.
Assistant, First Class, Plant Pathology Laboratory.	Arthur Disbrowe Cotton, F.L.S.
" " "	William Broadhurst Brierley, M.Sc.
" Second Class "	Mrs. N. L. Alcock.
Assistant Keeper, Jodrell Laboratory.	Leonard Alfred Boodle, F.L.S.
Keeper of Museums	John Masters Hillier.
Assistant, First Class	*John H. Holland, F.L.S.
" Second Class	*William Dallimore.
Preparer	George Badderly.

(19444—18.) Wt. 196—794. 1125. 10/18. D & S. 17/ 26

Royal Botanic Gardens, Kew—*continued.*

Curator of the Gardens	William Watson, A.L.S.
Assistant Curator	*William J. Bean.
Foremen :—	
Herbaceous Department	*Walter Irving.
Arboretum	*Arthur Osborn.
Greenhouse and Ornamental Department.	*John Coutts.
Tropical Department	*Charles P. Raffill.
Temperate House	*William Taylor.
Storekeeper	*George Dear.

Aberdeen.—University Botanic Garden :—

Professor	J. W. H. Trail, M.A., M.D., F.R.S., F.L.S.

Cambridge.—University Botanical Department :—

Professor	A. C. Seward, M.A., F.R.S., F.L.S.
Curator, University Herbarium.	——
Curator, University Museum.	H. H. Thomas, B.A.
Curator of Garden	*Richard Irwin Lynch, M.A., A.L.S.

Dublin.—Royal Botanic Gardens, Glasnevin :—

Keeper	Sir Frederick W. Moore, M.A., F.L.S.
Assistant	——

Trinity College Botanic Gardens :—

Professor	H. H. Dixon, Sc.D., F.R.S.

Edinburgh.—Royal Botanic Garden :—

Regius Keeper	I. B. Balfour, M.A., M.D., LL.D., Sc.D., F.R.S., F.L.S.
Assistant to Regius Keeper.	W. W. Smith, M.A.
Assistant (Museum)	H. F. Tagg, F.L.S.
,, (Herbarium)	——
,, (Laboratory)	M. Y. Orr.
Head Gardener	*R. L. Harrow.
Plant Propagator	L. B. Stewart.
Assistant Gardener	S. Stewart.
Foremen :—	
Arboretum	A. Johnstone.
Glass Department	J. J. Campbell.
Herbaceous Department.	——

Glasgow.—Botanic Gardens :—

University Professor	F. O. Bower, M.A., Sc.D., F.R.S., F.L.S.
Curator	James Whitton.

London.—Chelsea Physic Garden :—

Curator	*W. Hales, A.L.S.

Oxford.—University Botanic Garden :

Professor	Sydney H. Vines, M.A., Sc.D., F.R.S., F.L.S.
Curator	*William G. Baker.

AFRICA.

Union of South Africa.—

Pretoria.—Department of Agriculture :—

Chief, Division of Botany	†I. B. Pole Evans, B.Sc., F.L.S.
Mycologist - - -	Ethel M. Doidge, D.Sc., F.L.S.
„ (Herbarium) -	A. B. Bottomley, B.A.
Botanist („) -	Sydney M. Stent.
Assistant Botanist - -	A. O. D. Mogg, B.A.
Chief Conservator of Forests.	C. E. Legat, B.Sc.

Cape Town.—National Botanic Garden :—

Director - - - -	R. H. Compton, M.A.
Curator - - - -	*J. W. Mathews.
Gardener - - - -	*A. W. Maynard.

Durban.—Natal Herbarium— :

Mycologist in charge -	P. van der Bijl, M.A., F.L.S.

Cape Province.—

Cape Town.—Professor of Botany, South African College. D. Thoday, M.A.

South African Museum Herbarium:—

Assistant in charge -	——
Curator, Bolus Herbarium.	Mrs. F. Bolus.

Gardens and Public Parks :—

Superintendent - -	*G. H. Ridley.

Grahamstown.—Albany Museum :—

Superintendent of Herbarium.	S. Schönland, Ph.D.

Gardens and Public Parks :—

Curator - - -	E. J. Alexander.
Port Elizabeth - Superintendent -	John T. Butters.
King Williamstown. Curator - - -	George Lockie.
Graaff-Reinet - „ - -	*C. J. Howlett.
Uitenhage - „ - -	H. Fairey.

Natal.—

Durban.—Municipal Gardens :—

Curator - - -	*James Wylie.

Pietermaritzburg.—Botanic Garden :—

Curator - -	——

Transvaal.—

Pretoria.—Transvaal Museum :—

Superintendent of Herbarium - -	Mrs. R. Pott.

British East Africa Protectorate.—

Nairobi - -	Director of Agriculture.	Hon. A. C. Macdonald
	Mycologist - -	†W. J. Dowson, M.A.
	Chief of Economic Plant Division.	*Henry Powell.
	Agricultural Instructor, Coast Region.	G. Farmer.
	Conservator of Forests	E. Battiscombe.

Egypt.—

Cairo.—Ministry of Agriculture :—

Consulting Agriculturist.	Gerald C. Dudgeon F.E.S.
Inspector General -	A. T. McKillop.
Botanist - - -	B. G. C. Bolland, B.A.
Director of Horticulture.	*T. W. Brown, F.L.S.
Assistant Director -	*F. G. Walsingham.
,, ,,	*G. S. Crouch.

Gold Coast.—Agricultural Department :—

Director of Agriculture.	W. S. D. Tudhope.
Assistant Director and Mycologist.	R. H. Bunting.
Travelling Instructor	*Alfred E. Evans.
Agriculturist - -	H. G. S. Branch.
Senior Curator - -	*A. C. Miles.
,, ,, -	C. Saunders.
,, ,, - -	*A. B. Culham.
,, ,, - -	*T. Hunter.
Curator - - -	M. D. Reece.
,, - - -	*G. H. Eady.
,, - - -	*E. W. Morse.
Conservator of Forests -	N. C. McLeod.

Nigeria.—

Southern Provinces.—Agricultural Department :—

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Assistant Director -	A. H. Kirby, B.A.
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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 1] [1918

I.—PINUS CANARIENSIS.

J. Hutchinson.

(With Plates.)

In the *Bulletin de la Société nationale d'Acclimatation de France* for August, 1917, Dr. G. V. Perez, the veteran botanist of the Canary Islands, and an esteemed contributor and correspondent of Kew, calls attention to the merits of the native pine, *Pinus canariensis*, C. Sm., as a timber tree. Dr. Perez predicts a great future for this species in the reafforestation of those countries bordering the Mediterranean, where the forests are being rapidly denuded for war purposes, and considers it to be the most suitable tree for much of the North African Coast from Morocco to Egypt. He comments on British wisdom in planting the tree extensively in South Africa, where it succeeds admirably,* and in Australia and New Zealand where it is being tried.†

In such regions it is recommended as being invaluable for railway sleepers, mining, and all kinds of construction, its durability when exposed to inclement conditions being phenomenal. As evidence of this may be mentioned the perfect preservation of the ancient native wine presses of Tenerife (there is one in the wood museum at Kew), which are made of the Tea or heart wood of *Pinus canariensis*, and are reputed to be more than two hundred years old. The weight of a cubic foot of the heart wood is given as 68 lbs. 3 oz. (*Kew Bull.* 1915, 266). These wine presses are made of large massive beams which could only have been procured from very big trees, few of which now remain. Some of these giants had trunks measuring as much as 6 ft. 6 in. in diameter, truly colossal proportions compared with the size of the majority of the trees in the islands at the present time. Above the village of Vilaflor, to the south of the Peak of Tenerife, there still exists a group of these giants at an altitude of about 7400 ft. One of these, according to Dr. Perez, is about 160 ft. high, and 36 ft. in circumference! The trees of the forests now clothing the

* cf. Cape of Good Hope. Reports on Forests.

† The species apparently grows well in Cyprus and may be found a suitable tree for planting in the Island.

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slopes of the Canaries are rarely more than half this size. The native pine wood was also used extensively for the construction of the balconies of the older houses, and all are in an excellent state of preservation and frequently most elaborately carved.

Dr. Perez refers to a paper (not seen by us) on *Pinus canariensis* by F. Albert, the chief of the Forestry Department of Chile, where the tree is being experimented with and where it is growing extremely well. Mr. Albert has studied the climate of North Africa, and gives preference to *Pinus canariensis* for the coast land, up to an altitude of 4600 ft., from Egypt to Morocco. The average annual growth of the trees exceeds $3\frac{1}{4}$ ft. and $\frac{1}{3}$ in. in diameter, so that in 20 years they would be anything from 60-90 ft. high, with a diameter of 8-10 in. The trees are best planted about 4 ft. apart, or in very dry places a little over 3 ft., for this species, like *Pinus longifolia*, gives a considerable amount of ground shade.

A good feature of the tree is that it possesses a straight trunk even when grown singly; and in South Africa* it has been demonstrated at Fort Cunynghame that it recovers from damage by fire in a most striking manner, due probably to its thick heavy bark. Dr. Perez records fine examples of the species in Central France, and at La Mortola, in Italy, where there is a specimen 70 ft. high and $7\frac{1}{2}$ ft. in circumference. Mueller† says that the tree thrives well in Victoria, showing celerity of growth, and enduring an occasional shade temperature of 118° F. He recommends the species for the lower mountain regions of Victoria, which are subjected to moderate but never lengthened frosts.

According to correspondence from Mr. D. E. Hutchins, formerly forest officer in South and British East Africa, exotic pine trees have so far failed to succeed in the British East African Protectorate, due possibly to the rich humus soil and a deficiency of mycorrhiza, for according to Stahl‡ Conifers cannot thrive under such conditions. Stahl's explanation is that in humus there is so much competition for the nutritive salts that plants with slow transpiration, such as Conifers, are unable to absorb sufficient food without the co-operation of certain fungi as mycorrhiza. In volcanic and sandy soils where there is less competition the same kind of plants can obtain the necessary food material by means of their own roots and without the aid of other organisms. Mr. Hutchins considers *P. canariensis* a suitable tree for growing in the East African highlands.

In selecting sites for the planting of *Pinus canariensis*, the natural habitat of the species is worth consideration. We understand from Dr. Perez's article that Mr. Hutchins has recently visited Tenerife for this purpose. The tree is most abundant in the Western Canaries, i.e., in the islands of La Palma, Tenerife, Grand Canary, Gomera and Hierro, where the winter rainfall is considerable and the soil is volcanic. It is

* Union of South Africa, Forestry Report, 1912, p. 18.

† F. von Mueller, Suggestions for the Maintenance, Creation, and Enrichment of Forests, 15.

‡ E. Stahl in Pringsh. Jahrb. xxxiv. 607 (1900).

I.

PINUS CANARIENSIS IN THE BARRANCO DEL RIO.

[*To face page* 2.

II.

entirely absent from the two eastern islands, Fuerteventura and Lanzarote, whose climate and vegetation approximate very closely to that of the neighbouring African coast, and where the rainfall is only about 5 in. The Pine forest near the coast in the western islands has been cut down so severely that it is rarely found below 2500 ft., and much of it only commences about 4000 ft. Thence it is found in considerable abundance up to 8000 ft., where the specimens become very dwarf and stunted. In this area it frequently entirely covers the slopes and ridges of the narrow gorges (barrancos), often being found amongst the hard rocks where there is scarcely a particle of soil, but where it can send its roots down amongst the crevices.

The species is confined to the Canary Islands, where it is the chief constituent of the arboreal vegetation, mostly forming pure forest. Being the dominant tree of the archipelago its absence from Madeira and the Azores, with similar climates, and sharing much of the indigenous flora, especially trees and shrubs, is very remarkable. Of the four interesting Lauraceous trees of the Canaries, *Phoebe barbusana*, *Ocotea foetens*, *Laurus canariensis* and *Persea indica*, all occur in Madeira, and the latter two in the Azores. In this respect the finding by Carl Lindman* of pieces of Canary pine in the driftwood of the Norwegian Coast between Drontheim and Tanafjord is interesting, and it was probably carried there by the Gulf Stream. The nearest living relatives of the Canary pine are Mexican species, whilst a very closely allied fossil species† has been found in the lava of the Cantal district, South Central France.

In 1913, whilst on a visit to the island of La Palma (see *Kew Bull.* 1913, pp. 287-299), the writer had a good opportunity of exploring the forests of native pine, which cover the middle and upper slopes of the mountains, especially when ascending to the Pico del Cedro (l.c. 294) and whilst botanising in the great crater or Gran Caldera (p. 296), for which this island is justly famed. The photograph reproduced in Plate i. was taken in the Barranco del Rio, a deep rocky ravine to the north-west of Santa Cruz de la Palma. In this ravine the Canary pine is very abundant and covers the slopes from top to bottom, many of the specimens towards the dry stream bed being about 100 ft. high with stems about $2\frac{1}{2}$ ft. thick. The second photograph (Plate ii.) shows the trees in the bottom of the crater, occupying even the hard pinnacles of basalt where there is scarcely any soil. The peaks in the distance are over 7000 ft. high, and about 6000 ft. above the nearly dry river bed in the foreground, which in the winter is a raging torrent, but which in summer supports an annual crop of very interesting plants.

* Lindman in Götesborgs Konig. Vet. o. Vitt. Sanch. Handl. (reviewed in Just, Jahresb. 1883, pt. ii, p. 125).

† Saporta in Comp. Rend. Paris, civ. 954–7 (1887).

II.—THE GENUS RHIZOPHORA IN BRITISH GUIANA.

Alleyne Leechman.

During a detailed study of the Flora of the sea-shore, undertaken by the writer during the past three years on a two-mile stretch of the coast in the immediate neighbourhood of Georgetown, the capital of British Guiana, it has become evident that there are three distinct forms of the genus *Rhizophora* present on the area under investigation. Their more obvious distinguishing characters are:—

Form i.—Inflorescence simple, few-flowered (2-3, occasionally 4); radicle up to 30 cm. in length; fruiting profuse. (= *R. Mangle*, L.)

Form ii.—Inflorescence much branched, many-flowered; flowers as in Form i., but slightly smaller; radicle, as in Form i.; fruiting much less profuse. (= *R. Harrisonii*, Leechman.)

Form iii.—A more robust plant than either i. or ii.; inflorescence much branched, many flowered; buds and flowers stouter than in either i. or ii., and calyces not so yellow externally; radicle up to 65 cm. in length, usually curved at the upper third; pericarp stout and curved. (= (?) *R. racemosa*, G. F. W. Meyer.)

Forms i. and ii. are common in the area studied, and all three are sharply defined. They grow closely together on the same ground, and retain their distinguishing characters. Form iii. is, however, rare in the area (sea shore near Georgetown and banks of the Essequibo river) and is evidently depauperate in the conditions prevailing. The contrast between Forms i. and ii. in fruiting habit is very striking—Form i. often sets fruit abundantly, while Form ii., although blossoming profusely, seldom sets more than a few straggling fruits per tree, and many specimens are quite barren.

Grisebach, in his Flora of the West Indies, describes only one species of *Rhizophora* (*R. Mangle*, Linn.), from that part of the world. In his description he states that the inflorescence is "usually few-flowered". Another species—*R. racemosa*, Meyer—is mentioned by him, but not described.

Jacquin's long and delightful account of *Rhizophora Mangle* leaves no doubt as to the identity of my Form i. "Pedunculi communes axillis insident solitarii" he writes, "pollicares, compressi, sulco longitudinali exarati, *biflori, bifidi, interdum triflori et obsolete trigoni*",† and of the "seed", which he states is the longest part of the fruit, "pollices decem ut plurimum longa". His drawing of the

* "Stirpes americanae," p. 141, pl. lxxxix.

† The italics throughout are mine.—A. L.

fruit is poor and contrasts unfavourably with his excellent representation of the inflorescence and flowers.

It is evident that my Form i. is *Rhizophora Mangle* as defined by Jacquin.

Meyer's description of *Rhizophora racemosa** is less satisfactory. "Inflorescentia composita haec stirps insigni modo a *Rhizophora Mangle cui ceterum similis discrepat*" he remarks. But both my Forms ii. and iii. have compound inflorescences, and they are clearly distinct species. Of the cymes Meyer says "rami et ramuli *crassi* . . . quinquies vel sexies repetito-dichotomi . . . multiflori . . . in utraque dichotomia e margine calyciformi sexdentato enati", all of which agrees with my Form iii.; but he concludes with "flores et fructus *Rhizophorae Mangle*, sed petala pilosa". The flowers and fruit of my Form ii. may be said to be those of *R. Mangle*, but the flowers of my Form iii. differ distinctly in their more robust habit, in their shape which is not campanulate—and in the colour of the calyx, which is often quite green on the external surface, and is seldom bright yellow. The ripe buds—which I have found very useful for diagnostic purposes—are elliptical or slightly ovate, instead of cuneate as in the case of *R. Mangle*. The radicle, too, before the fruit falls is at least twice as long, generally strongly curved in its upper third, and green except at the distal end where it may become reddish-brown. *R. Mangle* has a radicle which is frequently entirely red-brown. Moreover, the pericarp of my Form ii. is very stout and is often curved. The petals in fresh specimens of my Form iii. are uniformly white and in my experience never saffron-yellow.

As to the leaves, Meyer's "foliis obovato-oblongis obovatisque" fits Form iii. very well, and the size given by Meyer—"uncias 4-5 longa, 2 lata"—also corresponds, but "subtus tenuissime tuberculata, punctis albidis adspersa" I cannot reconcile with any of my specimens. The spots on the dorsal side of the leaves are dark brown or blackish—"punctis *nigricantibus adspersa*" is Jacquin's phrase for the leaves of *R. Mangle*, which in this respect are similar to those of all the varieties examined by me. The spots are lenticels, formed by a hemispherical mass of wound cork, which develops round a stoma, isolating and killing it. It does not seem possible that such a structure could give rise to a white spot.

Oliver, in describing *Rhizophora racemosa* from Tropical Africa, says "Flowers in pedunculate, divaricate, shortly-jointed, many flowered cymes . . . pedicels and joints of cymes $\frac{1}{4}$ in. more or less". In my Form iii. the joints of the cymes are distinctly shorter than in Form ii., and sometimes may be actually stouter—which may account for Meyer's term "crassi". I am indebted to Dr. Stapf for the information that the plant generally accepted as *Rhizophora racemosa* from Africa closely resembles my Form iii. except for the petals, which are perhaps a trifle shorter and broader; and that Engler in Martius' "Flora brasiliensis" and Huber in "Arboretum amazonicum" mention

* "Primitiae Florae Essequeboensis," p. 185.

a *Rhizophora Mangle* var. *racemosa* but without discussing its peculiarities beyond the statement that its inflorescence is repeatedly branched. Oliver remarks that *R. racemosa* "occurs also in Tropical America, if this identification is correct".* It must be noted that Oliver describes *R. racemosa* as "a small tree", whereas in British Guiana, so far as I have seen, it is the largest of the three species I have noted. In British Guiana it is certainly a larger plant, in every way, than *R. Mangle*, which is described by Jacquin as attaining a height of "quinquagintapedalem . . . plerumque".

As Dr. Stapf very justly points out, it is not possible to decide the identity of my Form ii. with Meyer's *racemosa* until we are in a position to compare Meyer's orginal specimen of this species. It seems advisable, then, for the present to refer my Form iii. tentatively to *Rhizophora racemosa*, and to regard my Form ii. as a new species, for which I propose the name *Rhizophora Harrisonii*.†

I suggest the following diagnosis of my Form iii.

Rhizophora racemosa, *G. F. W. Meyer* (descr. emend.); a *R. Mangle*, L., inflorescentia dichotomo-paniculata, a *R. Harrisonii*, Leechman, pericarpio crassissimo et radicula longissima ad 65 cm. longa distincta.

Arbor magna, ad 25 m. alta, radicibus aeriis a ramis superioribus descendentibus. *Folia* 10-12 cm. longa, 4-5 cm. lata, supra saturate virentia, subtus punctis nigricantibus adspersa. *Petioli* crassi, 1·5-3 cm. longi. *Rami et ramuli inflorescentiae* crassi, seriatim breviores—pedunculi plus minusve 3 cm. articuli 10-5 mm. longi—in utraque dichotomia e margine calyciformi sexdentato enati. *Inflorescentia* ramosissima, quinquies vel sexies repetito-dichotoma, articulata, multiflora. *Alabastra* pallide flavo-viridia, ovata vel elliptica, 10-12 × 6-7 mm. *Calyx* viridis vel externe pallide flavescens, profunde quadripartitus, persistens, segmentis crassis ovato-lanceolatis subacuminatis coriaceis 10-12 × 6-7 mm. leviter patentibus. *Petala* 4, candida, linearia, acuminata, margine obsolete hirsuta, inter lacinias calycis valde reflexa, quibus paulo breviora et multo angustiora, caduca. *Antherae* saepe 8, aequales, aliquando 9-13 et, inaequales, corolla paulo breviores, caducae. *Stylus* fortiter sulcatus; stigmata 2-3, rarius 4. *Pericarpium* 4-5 cm. longum, 2 cm. latum, ovatum, crassum, scabriusculum, aliquando obsolete maculatum, saepe curvatum. *Radicula* omnium longissima, ad 65 cm. longa, pallide viridis, saepe curvata, apicem versus ferruginescens et sensim saepe ad 1·5 cm. incrassata.

This species appears to be the prevailing river type, and at Bartica, some 40 miles up the Essequibo River, it is the dominant mangrove plant.

* "Flora of Tropical Africa," vol. ii, p. 408.

† In honour of Professor J. B. Harrison, C.M.G., M.A., Director of Science and Agriculture in British Guiana.

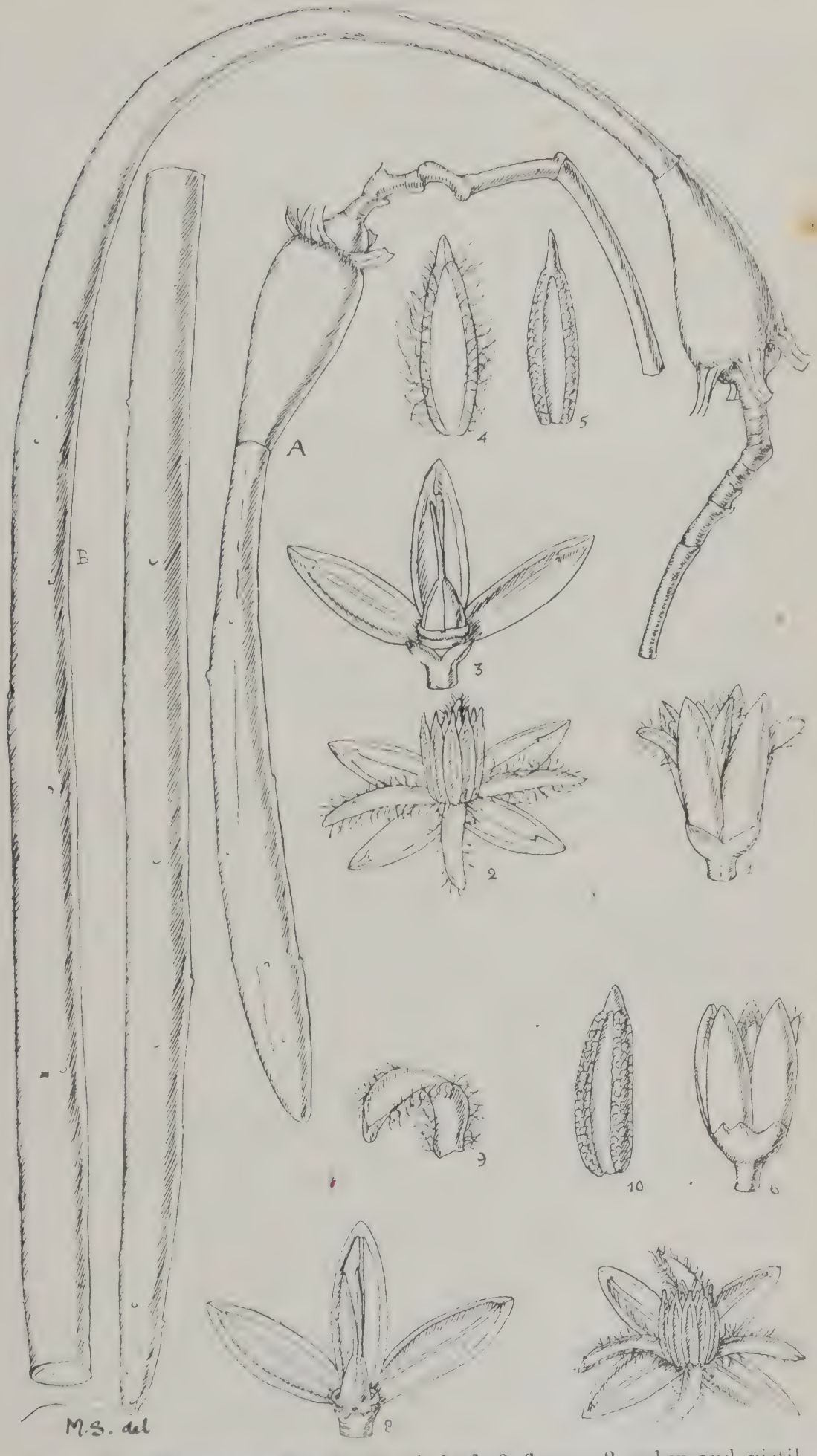

Fig. A. *Rhizophora Harrisonii*.—1. bud, 2. flower, 3. calyx and pistil, 4. petal, 5. stamen.

Fig. B. *Rhizophora racemosa* (?)—6. bud, 7. flower, 8. calyx and pistil, 9. petal, 10. stamen.

The figures have been drawn by Miss M. Smith from material sent over in spirit from British Guiana.

Form ii. may be defined as a new species, thus:—

Rhizophora Harrisonii, *Leechman*; species nova a *R. Mangle,* L., inflorescentia composita, a *R. racemosa*, Meyer, pericarpio gracili et radicula brevi distincta.

Arbor ad 20 m. alta, radicibus aeriis crebris a ramis superioribus descendentibus. *Folia* iis *R. Mangle* similia sed ferme elliptica, 11-15 cm. longa, 4-7 cm. lata, supra virentia, subtus punctis nigricantibus adspersa. *Inflorescentia* ramosissima, quinquies vel sexies repetito-dichotoma, articulata, multiflora. *Rami et ramuli inflorescentiae* graciles, pedunculi plus minusve 45 mm. longi, articuli seriatim breviores—20, 11, 9 et 7·5 mm. longi—in utraque dichotomia e margine calyciformi inaequaliter sexdentato enati. *Flores* iis *R. Mangle* similes sed minores, 1·3 cm. longi, suaveolentes, praesertim sub occasum solis, demum campanulati. *Alabastra* flavescentia, ovato-lanceolata, 11 × 5 cm. *Calyx* flavescens, profunde quadripartitus, persistens, segmentis coriaceis lanceolatis acuminatis 13 × 4 mm. demum late patentibus. *Petala* 4, candida, linearilanceolata, acuminata, margine saepe hirsutissima, demum inter segmenta calycis valde reflexa, quibus paulo breviora, caduca. *Antherae* 8, corolla breviores, aequales, caducae. *Stylus* leviter sulcatus; stigmata semper duo. *Pericarpium* rectum, plus minusve 4 × 1·5 cm. ovato-lanceolatum, scabrum et saepe maculatum. *Radicula* ad 30 cm. longa, omnino ferruginescens.

The robust habit, dark-green foliage, stout panicles and huge radicles of my form iii. (? *R. racemosa*) make it very easy to distinguish it from *R. Harrisonii* even from a distance. I hope soon to be in a position to add details of the distribution in British Guiana of these three species of *Rhizophora.*

I am indebted to Dr. Stapf for valuable advice and assistance, and I am also obliged to Mr. J. Rodway, F.L.S., of Georgetown, for the loan of the works of Jacquin and of Meyer to which reference has been made.

III.—DISEASES OF PARSNIPS.

STUDIES FROM THE PATHOLOGICAL LABORATORY: VI.

A. D. COTTON.

(With Plates.)

The attention of the Board of Agriculture and Fisheries was drawn last winter to the trouble known as "Parsnip Canker." The losses of parsnip roots through this trouble proved so serious, especially in parts of Worcestershire, that it appeared advisable to make the matter the subject of special enquiry. Two visits for this purpose were paid to Evesham and district, and considerable light on the subject has been obtained. At the same time several other minor diseases of parsnips, three of which were new to the country and one apparently capable of causing severe

damage, were noted. In the present paper the results of the investigations on Canker are recorded, as well as observations on the other diseases.

Canker.

That a certain number of parsnip roots in all parts of England are annually disfigured through surface-injuries on the shoulder is common knowledge, and that in some cases serious decay follows is also well known. In certain localities this decay, which occurs in late summer and autumn, is very prevalent, and is termed "Canker" or "Rust." The name is loosely used and the trouble not easy to define; it has apparently never been specially investigated. The brownish-coloured rot shown by affected specimens is not a characteristic symptom, but is common to other types of injury, being due largely to the oxidation of substances in the mucilage present in the parsnip root. The term "canker" as used by growers implies a more or less open wound, at first brownish-red in colour, which affects the shoulder or upper part of the root, and frequently leads in bad cases to the destruction of the entire root (see plate iii).

Damage in 1913 crop.—The trouble reported from Worcestershire at first seemed to be of a more definite nature, the roots having the appearance, in certain cases at all events, of a black wet rot. The specimens were communicated by Messrs. Yates & Sons, seed merchants and growers of Evesham, in December, 1916, and throughout the investigation Messrs. Yates have most freely given valuable help and advice. A large number of bacteria and fungi were present in the decaying roots, and in certain specimens the margins of the blackened areas were permeated almost exclusively by a fungus referable to the genus *Phoma*. The fungus was easily isolated and grew freely on various media, but was not found to agree satisfactorily with any described species of that genus. It was subsequently ascertained that this black rot was a special form of decay, and that canker was not associated with any particular fungus, but arose from a surface wound, which, invaded by various kinds of micro-organisms, rapidly led to the destruction of the root-tissues.

In the Evesham district it was estimated that 10 per cent. of the entire crop was lost through canker, and this, judging from figures supplied by Messrs. Yates, would amount to a loss of 370 tons of roots from seed supplied by their Evesham branch alone. In certain fields the loss was very severe; 50 per cent. of the crop in more than one case was stated to have been rendered unsaleable.

Field Observations.—Owing to the ground being frozen during the severe weather of January and February, a visit to affected areas was postponed till the beginning of March. By this date very few sound parsnips were to be found in the field in the neighbourhood of Evesham In the localities visited the upper part of the root just visible above the soil was almost invariably undergoing decay through a white or grey wet-rot,

largely bacterial, the initial injury in most cases being probably due to some other cause. No specimens of the black *Phoma* rot were seen. It was ascertained that a more or less severe form of canker occurred over a wide area around Evesham, also in parts of Gloucestershire, whilst roots received from Somerset were almost completely destroyed through the same cause. In some cases where no rot, either wet or dry, was present a certain amount of the so-called canker was definitely attributed to the workings of Carrot Fly, and injury by this pest was found subsequently to be very considerable (see Bd. Agric. Leaflet No. 38).

At this season it was obviously too late to obtain a general insight into the nature of canker and of the black rot. A few simple tests, with regard to soil and culture for the coming season, were therefore arranged pending further examination in September, about which date canker was said to commence. These experiments included the dressing of the soil with lime, soot and sulphate of ammonia. This was carried out by several growers near Evesham, the fields being divided into four plots, the fourth plot being left as a control. Considerable improvement was expected from the use of lime, as, judging by the abundant growth of sorrel, the soil in some fields was decidedly acid. Trials at Kew were also planned, as described later.

At the beginning of September another visit was paid to Evesham. The fields of seven large growers were inspected, and also the gardens of several others where parsnips were grown on a smaller scale. By this date canker had been reported from several market gardens, and, as was subsequently discovered, was in certain localities far advanced. It was regarded as being on the whole decidedly earlier in its appearance than in previous seasons. No destructive black rot was observed, though in advanced cases a grey, wet rot had commenced. Canker was noted as being more prevalent on forked or mis-shapen roots.

The effect of the various dressings employed was first examined. To form a really true estimate it would have been necessary to lift a large number of roots and have a somewhat detailed knowledge of the character of the soil and its previous history with regard to manuring. This much, however, may be said: in most fields the distribution of the canker appeared fairly uniform and to be unaffected by the dressings which had been applied. The application of sulphate of ammonia did not apparently result in any very great increase in the growth of the parsnip nor in the amount of disease. No very striking results were, however, anywhere apparent, though, on the whole, canker appeared to be distinctly worse where liming in the past had been omitted.

With regard to the physical nature of the soil and its relation to canker, in the opinion of several growers the driest lands suffer most severely. Without controverting this statement it may be mentioned that it was not corroborated during the visit. The two worst and most advanced stages of decay were found in both cases on wet heavy land (Pebworth and Sedgeberrow). A bad case was noted on light land (Fladbury). On the whole, canker appeared least prevalent on medium loam.

Animal and fungus injury were next searched for. The former was observed in some variety. The workings of the carrot fly larvae were manifest both in field and garden crops. Slug-injury was also noted, and the occasional presence of wireworms and surface caterpillars (*Agrotidae*), locally termed "leather grubs," doubtless accounted for other damage. The millipede (*Julus pulchellus*) was often abundant in the decaying parts. These animals, however, were far too few in number and too irregular in distribution to be for a moment considered as being primarily responsible for canker. Carrot fly was the most general, but it was usually sparsely distributed except in small gardens and allotments, and the characteristic tunnellings which the larvae produce, not only on the shoulder but in all parts of the outer tissue of the root, form a very definite and distinct type of injury.

Cause of Canker.—The cause of canker was more satisfactorily sought for in injuries noticeable at once in examining slightly attacked specimens—namely, the cracking of the outer skin of the root. This cracking was noted the first day, and, without ceasing to search for all indirect and subsidiary causes, was made the subject of special investigation during the remainder of the visit. The cracks were, as a rule, $\frac{1}{2}$ to 2 in. long and $\frac{1}{10}$-$\frac{1}{2}$ in. across, and occurred either as vertical concentric slits around the top of the shoulder or ran horizontally around it at a distance of not more than about $1\frac{1}{2}$ in. below the top. Vertical cracks running down the side of the root were also present, and these appeared to be formed simultaneously with the horizontal ones to which they were, as a rule, united at their upper end. The cracks were entirely superficial, being confined to the periderm and a few layers of cortical cells. They gaped considerably, and exposed the cortex to view as a soft white spongy tissue.

The stages of decay from badly cankered spots to small and sound cracks could be traced without difficulty (see Plate iv). The fresh wounds were perfectly clean (Plate iv, figs. 1 and 2), but the cortical tissue within soon became attacked by animals, such as slugs and centipedes, and by various fungi and other micro-organisms. The cracks were obviously due to the expansion of the root-tissues and not to the agency of outside organisms, and were comparable to the familiar growth-cracks in carrots, but were mainly horizontal instead of vertical, and differed strikingly in being confined practically to the outer skin or rind. Subsequent observations entirely confirmed the view that canker originated from these surface lesions. That it may follow as a result of other wounds, such as carrot-fly injury is possible and even probable, but it was obvious that a very large proportion of the trouble in Worcestershire is, primarily, due to this rupture of the periderm. The cause of crack-formation and subsequent decay of the inner tissues is discussed later.

Experiments at Kew.—Although the origin of the canker had been traced to the surface lesions described above, the organisms concerned with the actual decay had not been classified and

isolated. Their distribution in the soil and their relative abundance in different localities was unknown. For this reason the results of the soil experiments at Kew arranged the previous spring may be recorded here. Five plots of Parsnips were sown in April 1917, and were treated as follows:—

Plot A inoculated with 2 bushels of infected Evesham soil.
Plot C inoculated with cut-up diseased roots from Evesham.
Plot D inoculated with cut-up diseased roots from Somerset.
Plots B and E served as controls.

The diseased roots and soil which were obtained from Worcestershire and Somerset in March were added with a view to inoculating the soil with any organisms, parasitic or otherwise, which might be concerned with the production of canker. The variety of Parsnip sown was the same as that very largely used in Worcestershire, a broad-shouldered form of "Hollow Crown."

Preliminary examination in August and September showed the presence of many small cracks, but no marked development of canker. The plots were finally cleared on November 12, by which date a considerable number of cankerous wounds had developed. The results are set out in the accompanying table:—

			per cent.
Plot A.—Inoculated with Evesham soil (total number of plants = 96).	Sound	65	68
	Cracked	17	18
	Cankered or commencing to canker	14	14
Plot B.—Control (total number of plants = 178).	Sound	103	58
	Cracked	42	23
	Cankered or commencing to canker	33	19
Plot C.—Inoculated with diseased roots from Evesham (total number of plants = 76).	Sound	50	66
	Cracked	13	17
	Cankered or commencing to canker	13	17
Plot D.—Inoculated with diseased roots from Somerset (total number of plants = 99).	Sound	62	63
	Cracked	22	22
	Cankered or commencing to canker	15	15
Plot E.—Control (total number of plants = 168).	Sound	118	70
	Cracked	26	15
	Cankered or commencing to canker	24	15

From the above it will be seen that from 15-23 per cent. of the cracking occurred in all plots, and from 14-17 per cent. of canker. The figures for the latter are high, but except in plot C the canker was in an early stage, and the roots were marketable and not appreciably damaged. In plot C eight roots had badly decayed, but from the presence of equally severe injury noted in some neighbouring plots (not included in the experiment) this

cannot, without further proof, be attributed to the effect of the inoculation with diseased roots. It may be due to early cracking and early commencement of decay. The experiment tends to show that inoculation with diseased material had no effect, since of the controls one (B) showed the maximum amount both of cracking and of canker, and the other (E) almost the minimum.*

In addition to the above, efforts were made by means of direct observation of roots in the Kew plots to follow the course of development of the cracks and the subsequent decay. The results were not conclusive—a fact which may be partly due to the observations being made late in the season, namely, in September, after the return from Worcestershire. Nine growth-cracks on roots in plot B were carefully examined and measured, the roots being left *in situ*, the soil merely scraped away for purposes of inspection, and replaced at once. The weather was somewhat dry for the first ten days after marking. After two weeks the plots were examined, when but little extension of the cracks and no decay had taken place. Two weeks later, after considerable rain, a little decay had commenced and some new cracks had appeared. After another fortnight, *i.e.*, six weeks after marking, the roots were lifted and examined, with the following results:—Three slits had not increased in size and remained sound, 3 had distinctly increased in size yet remained sound, 3 had increased in size and developed cankerous wounds. Some 6 or 7 new cracks had developed, all of which remained sound.

In another set of roots on the same plot a series of shallow vertical cuts on the top of the crown resembling growth-cracks were made with a knife. Examined 6 weeks later, four remained sound and two developed into a cankerous wound.

A similar experiment was performed on plot C (infected soil) with the addition of 12 horizontal cuts on the side of the root. All these cuts, however, remained sound. It was noted that an injured surface attracted slugs, slug-injury being obvious both in growth-cracks and artificial cuts.

Summing up the Kew experiments, it may be said (1) that growth-cracks occurred at Kew as in Worcestershire, but they were decidedly smaller in size and later in developing; (2) that canker followed in a few cases as a result of these or other injuries; and (3) that canker was found to be no more frequent in the plots inoculated with Evesham soil or with diseased roots from Evesham than in the ordinary Kew soil. The less extensive cracking may perhaps be accounted for by the small size of the roots. This was due to the seed being sown late (mid-April) and the soil being a heavy compact silt which had not been manured for two years.

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* Experiments carried out by Messrs. Yates at Evesham for testing the effect of manures showed a distinctly larger percentage of canker than at Kew. The use of lime proved highly beneficial both with regard to size of roots and reduction of canker. The use of manures alone, such as Peruvian guano, sulphate of ammonia and superphosphate of lime, was not successful in mitigating the disease.

Anatomical considerations.—The parsnip root consists of a central core of xylem surrounded by a mass of soft spongy parenchyma. The whole is bounded by a thin periderm. The relative amount of core and soft outer flesh differs somewhat in different varieties, but as a rule the fleshy tissue is largely in excess of the core, and it is the aim in selection to keep the central core as small as possible. The core is composed almost exclusively of secondary xylem, but it contains a very large amount of xylem parenchyma, hence it is comparatively soft. The outer fleshy portion consists essentially of secondary cortex; it is composed entirely of parenchymatous and other soft elements which are produced abundantly from the cambium. The cells are densely packed with starch. Through the cortex runs a system of mucilage canals, which are especially found immediately beneath the periderm. The secretion may be seen exuding from roots on freshly cut surfaces as a white milky fluid, which turns reddish-brown on exposure to the air; this change of colour, as is shown by the guaiacum test, is due to the oxidation of some substances contained in the fluid.

The periderm surrounding the root is formed from a phellogen which arises in the inner tissues of the root, probably in the pericycle, at a very early stage. In the young growing apex of the root the phellogen and three or four layers of periderm are clearly visible in transverse section. In older roots the periderm appears, owing to tangential stretching, to be less regular. In median longitudinal section, however, the regular arrangement of the cells, obviously of secondary origin, is quite clear. This thin layer of periderm is interrupted only in the furrows marking the emergence of the lateral roots, where a thick pad of corky tissue is present.

It is obvious to the naked eye that the cortical tissue exposed to the air as a result of cracking does not heal over. Anatomical examination shows, however, that an attempt is made on the part of the plant to protect itself, inasmuch as the outer and side walls of the exposed cells become suberised. A few cell-divisions also take place, but there is no trace of a definite phellogen or of a layer of wound-cork. This protection is quite inadequate to keep out micro-organisms, the inter-cellular spaces and cracks or fissures due to drying providing ample means of entry. The soft parenchymatous tissues are, moreover, specially attractive to slugs, an immense amount of slug-injury being noticeable if large gaping slits are made with a knife. It is therefore not surprising that decay sets in and canker follows, and the cause may be said to be entirely due to the inability of the parsnip to form a protecting layer of wound-cork. The deep open clefts which occur in the roots of swedes, carrots, mangolds, and turnips become protected on their surfaces by a thin cork layer. No cork layer is formed when such deep cuts are made artificially in the parsnip. It would appear, therefore, that the hindrance to cork-formation is not due to the different method of cracking, but to some physiological peculiarity of the parsnip root.

The Causes of Cracking and Remedies.—The formation of growth-cracks is a phenomenon familiar enough to gardeners, and is of common occurrence not only in root crops, but in fruits such as apple, pear, and cucumber. In the pulpy fruits of plum, cherry, and tomato a cracking of the skin is also frequent, and in this case, as in the parsnip, decay results.

Cracking is brought about by an unequal growth in the structures concerned; the inner tissues grow more rapidly, and ultimately rupture the outer layers. In the case of the pulpy fruits mentioned, cracking may be partly due to excessive turgidity of the inner cells. In either case it is, as a rule, due to the effect of an abundant supply of water at the root after a dry period, but at times it appears to be merely the result of rapid growth, when the expansion of the surface tissues does not keep pace with that of the inner. The effect of hot sun and dry conditions, especially, if there is not a copious supply of water at the root, is to ripen growth, and this entails, amongst other things, loss of elasticity in the cell-walls and decrease of the power of cell-division. Dry conditions, whether in the case of fruits or roots, are felt first at the surface, and hence surface tissues are more subject to premature ripening. If late summer rains stimulate new growth, the outer, partly ripened tissues respond more slowly, and if the pressure from within be excessive they are liable to become ruptured.

The above considerations apply to the parsnip and explain to a certain extent the cause of cracking. It is obvious that the very wet September of 1916 following the warm, dry August was conducive to late and rapid growth, which would, for the reasons given, lead to extensive cracking of the surface tissues of the root, and an unusual abundance of canker. In 1917 canker may have been increased by the wet August. From information collected from various growers cracking was general in 1916 in parsnip-growing localities though the losses elsewhere were much less serious than at Evesham. One may inquire therefore as to the presence of special conditions at Evesham, which might tend to aggravate the trouble.

On the cultural side there is evidence of several contributory factors. In order to obtain a heavy crop the seed is sown in February, at an earlier date than formerly. By this method the roots reach a large size by July and August, and there is probably a tendency to premature ripening. This theory receives support from the fact that several growers maintain that liability to canker is lessened by late sowing. The soil itself may be too rich. Though fertilizers are never applied directly to the crop, the Evesham soil is well known often to be highly manured, and given favourable weather conditions this would lead to excessively rapid growth, and consequently risk of much cracking. A highly fed plant, moreover, would decay rapidly. In addition there is evidence, in the case of certain growers at all events, that parsnips are grown on the same land for two years in succession and that a proper rotation is not given. The effect of the latter course is not only unfavourable for parsnip growth, but tends to stock

the soil to the full with the particular organisms, both animal and vegetable, concerned in their decay, and hence if cracking occurs the parsnip might be expected to be rapidly destroyed. Lastly, liming has been neglected. Experiments carried out by Messrs. Yates in 1917 show a decided improvement where lime was applied.

Yet another cause of the severity of the canker attack may lie in the nature of the variety of parsnip grown. As already mentioned breeders aim at a small core and ample flesh, an ideal well seen in the Evesham parsnip root, which is noted for its bulky fleshy top. Such a soft mass of parenchymatous tissue would probably be easily stimulated to extensive growth after rainy periods during the summer months and to rapid expansion of the inner tissues. The breeders may have exceeded the limits in that direction and produced a parsnip particularly subject to a physiological defect. As evidence in favour of this view it may be mentioned that in allotments in Worcester, though the long slender parsnip such as "Student" showed rupturing of the rind and a certain amount of canker, these were not so extensive as in the Evesham parsnip.

Preventive Treatment.—In order to reduce the amount of surface-cracking and canker the following treatment, based on the above conclusions, may be recommended:—

1. Too rich a soil must be avoided.
2. Late sowing should be adopted. Such observations as it has been possible to make in 1917 tend to confirm growers' statements that plants sown in the end of April or beginning of May suffer much less than those sown in February.
3. Liming must not be neglected. As well as improving the tilth, lime acts by liberating reserves of nitrogen and potash, and its effect on the parsnip is seen in the improved quality of the crop both in size of roots and decrease in the amount of decay.
4. A dressing of salt has been found very effective by some growers. On heavy soils 5 cwt. per acre should be applied, and on light soils up to 10 cwt. per acre may be used. The salt may act by liberating a certain amount of potash from the soil, and one of the most marked effects of potash is to retard maturation and to enable the plant to continue its vegetative growth. It is possible that this effect may extend to the phellogen (rind-producing layer) and consequently render it less liable to rupture. For the same reason potash manures should prove beneficial.
5. A proper rotation should be given, and parsnips must never be grown for two years in succession on the same land.

Summary.—The canker of parsnip or the decay of the upper part of the root during late summer and autumn is a disease

well-known to growers, but one which has apparently never been investigated. In certain districts it has recently been on the increase and is responsible for serious losses. It is shown to be due primarily to a physiological phenomenon which causes the surface tissues to become ruptured, and not to the invasion of a fungus parasite. Cracking takes place during the growing season especially if rains follow a dry period, the portion involved being the skin, *i.e.*, the periderm and the outermost layers of the cortex. The cracks, which for the most part run horizontally around the upper part of the root but also in a vertical direction, are from $\frac{1}{2}$ to 2 in. long and gape open exposing the soft inner tissues.

The "canker" or decay which follows is shown to be the result of the inability of the parsnip to form a layer of wound cork. Though the outer walls of the exposed cortical cells become suberised and few cell-divisions occur no definite phellogen is formed, and the growth-cracks are not protected as they are in the case of carrots, swedes, and other fleshy roots. The suberisation of the outer walls is insufficient to exclude micro-organisms, which enter, probably by means of intercellular spaces and fissures due to drying, and more or less rapidly destroy the tissues of the root. Though canker is worse in some localities than others it appears to occur in all districts if rupturing of the skin takes place. No one micro-organism specially connected with the decay has been isolated.

The conditions leading to crack-formation are discussed. It is shown that whilst such cracks are due to an unequal rate of growth, the inner tissues growing more rapidly than the outer, and are governed very largely by weather-conditions, their formation may be favoured by certain methods of culture, namely, over-manuring, neglect of liming and by early sowing (inducing premature ripening). The variety of parsnip grown may also be partly responsible, a form of high quality, with bulky top, abundant flesh, and small core, being very largely cultivated in the worst infected areas.

Control measures consist in rectifying the faulty methods of culture alluded to, and the use of potash and common salt with a view to retarding maturation.

Other Parsnip Diseases.

Erysiphe Polygoni, *DC.*, The Parsnip Mildew.

This fungus, which attacks many cultivated plants, occurs frequently on Parsnips, being found very plentifully in the market gardens around Evesham and Wisbech; it has also been noted elsewhere. The perithecia are found late in the season both on the leaf-blade and the petiole, but especially the latter. The attack is not sufficiently severe to necessitate treatment.

Phyllachora Pastinacae, *Rostr.* Plantepatologie, p. 511.

New to Britain. The conidial (*Cylindrosporium*) stage of this species was found attacking a certain number of parsnips with great severity in a market garden at Mickleton (Glos.). The disease shows itself first as brown spots on the upper

surface of the leaves. These later coalesce and form extensive brown areas. On the under side the minute sori are visible as black shining areas, just visible to the naked eye though they may ultimately reach 2 mm. in diameter. Occasionally they appear also on the upper surface. In bad cases the whole foliage including the petiole is attacked and killed, and as it becomes browned and scorched in appearance diseased plants stand out clearly in the field.

Although neither the ascigerous nor conidial stages of *P. Pastinacae* have been previously recorded for this country there can be little doubt that the fungus occurs frequently, but has been overlooked. Further it is probable, since their morphological characters are identical, that *P. Pastinacae* is synonymous with *P. Heraclei* which is not uncommon in England on Cow Parsnip (*Heracleum Sphondylium*). The parasite has undoubtedly spread to the cultivated from the wild plant and is attacking it severely, a disquieting circumstance in view of the fact that there is some evidence that the now widespread and injurious Celery Blight (*Septoria Apii*) originally spread to Celery from the wild *Apium* (*vide* Pethybridge, Journ. Roy. Hort. Soc. vol. xl., pp. 476-480). The spore measurements of the conidial stage given in Saccardo are incorrect, and a revised description is given below.*

P. Pastinacae, *Rostr.—Cylindrosporium Pastinacae,* Lind. Danish Fungi, p. 493. *Septoria Pastinacae,* Westend. Herb. Crypt. Belg. no. 639.

Sori on the under side of the leaf, scattered or gregarious, not on distinct spots, immersed in the tissue of the leaf. Pycnidial wall lacking, spores set free through the ruptured epidermis. Conidia hyaline, strongly curved, falcate, ends rounded, at first with a few oil-drops, finally 1-septate, rarely with a second septum, 50-70 × 4-5 μ.

Ramularia Pastinacae, *Bubák.*

New to Britain. The fungus, which was usually accompanied by *Cercosporella Pastinacae,* Karst., forms small brown but conspicuous spots on the leaves, and elongated spots on the petioles. It was found generally distributed in Worcestershire and was noted also in Gloucestershire, and Cambridgeshire. It is probably widely spread in England but has been overlooked. On the leaves the spots are angular, being bounded by the veinlets (Text fig. 1a), a character which serves to separate it from *Cercosporella.* The spores show as a delicate white mould on the lower side.

In crowded gardens and allotments the spotting was severe and sufficient seriously to weaken the plants; in the open fields the damage was insignificant. The synonomy and description are as follows:—

* For assistance with regard to the identification, synonomy and description of these new records and also for the text figures, I am much indebted to Miss E. M. Wakefield of the Kew Herbarium.

R. Pastinacae, *Bubák* in Sitzber. böhm. Ges. Wiss. Prag. Sep. 1903, p. 19. ? *R. Pastinacae*, Lindr. et Vestergr. in Acta Soc. Faun. Flor. Fenn. xxii., No. 3, 1902, p. 8 (non *Cercosporella Pastinacae*, Karst. in Hedwigia xxiii., 1884, p. 63).

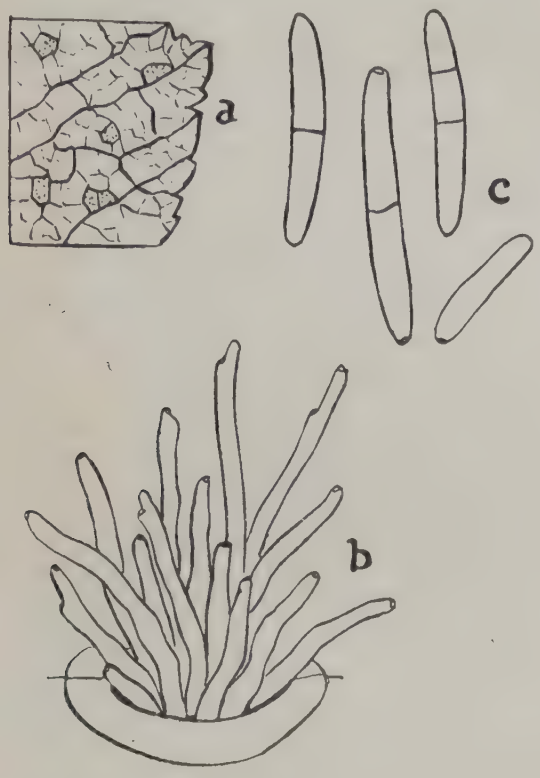


Fig. 1.—*Ramularia Pastinacae.*
(a) Portion of leaf showing angular spots (nat. size).
(b) Tuft of conidiophores emerging through a stoma (× 850).
(c) Spores (× 850).

Spots on the leaves, definite, more or less angular, limited by the veinlets of the leaf, 1-2 mm. in diameter, at first dark greyish-green, then brown; spots on the petiole, dark, much elongated up to 2 cm. long by 2-3 mm. wide. Sori minute, crowded, chiefly on the under-surface, but also epiphyllous, white or very pale rose-tinted. Conidiophores fasciculate, emerging from the stomata, cylindrical, unbranched, finally more or less toothed towards the apex, 30-75 × 2·4-4 μ. Conidia cylindrical, straight or very slightly curved, ends rounded, at length 1-septate, or rarely 2-septate, sometimes in short chains, 15-27 (9-35) × 3·5-4 μ

Text figure 1 a, b, c.

Cercosporella Pastinacae, *Karst.*

New to Britain. Found on leaves and petioles and closely associated with *Ramularia Pastinacae.* Only a slight attempt was made to separate the two fungi in the field from which it appeared that the *Cercosporella* is by far the least common. When unmixed with *Ramularia* the spots are round (text figure 2 a), but as a rule the two fungi occurred together and their general distribution appears similar.

With regard to the identity of the fungus there appears no doubt that it is the same as Karsten's. Lindroth and Vestergren

(Acta Soc. Faun. Flor. Fenn. xxii., 1902, No. 2, p. 8) stated that Karsten's fungus was a *Ramularia*, with 2-celled, rod-shaped conidia germinating soon after maturity. This description would apply to *Ramularia Pastinacae*, Bubák, but not to Karsten's own description of the long, tapering conidia. In view of the close association of the two species noted in England, it seems legitimate to conclude that Lindroth and Vestergren must have seen only the *Ramularia*, and erroneously supposed it to be Karsten's *Cercosporella*. They do not, moreover, state whether they examined the type material. The description is as follows:—

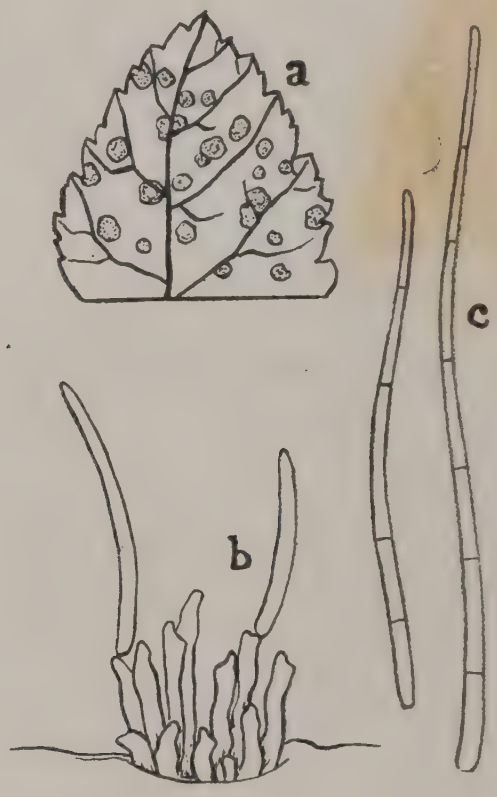


Fig. 2.—*Cercosporella Pastinacae.*

(a) Portion of leaf showing round spots (nat. size).
(b) Tuft of conidiophores with young spores (× 850).
(c) Spores (× 850).

C. Pastinacae, *Karst.* in Hedwigia, xxiii., 1884, p. 63.

Spots rounded, not bounded by the veinlets, 1-3 mm. in diameter, at first brown, then becoming white in the centre, with a light brown margin, edge slightly elevated on the upper surface of the leaf. Sori chiefly on the under side, but also epiphyllous, minute, white pulverulent. Conidiophores short, flexuous, indistinct, 10-20 × 2·5-3 μ. Conidia hyaline, slender, tapering gradually towards the apex, with 3-6 indistinct septa, 35-90 (-105) × 2·5 μ.

Text figure 2 a, b, c.

III.

PARSNIP CANKER.

[*To face page* 20.

IV.

PARSNIP CANKER.

To face page 21.]

Plasmopara nivea, *Schroet.*

In 1917 this well-known parasite on the *Umbelliferae* appeared on parsnips late in the season, being noted abundantly near Wisbech in the end of September. In October Messrs. H. Wormald and E. W. Swanton forwarded material from near Ashford and Haslemere respectively, and signs of its presence were observed later in several other localities. The fungus shows first as pale spots or ill-defined areas on the upper surfaces of the leaf with a delicate white mould protruding below. With age the spots increase in size and become dark in colour, forming irregular blotches several centimetres across, similar in form and appearance to those caused by *Phytophthora infestans* in potato, a character which distinguishes it from any of the other diseases previously mentioned. In one garden near Wisbech where parsnips were grown between fruit trees, a considerable amount of the foliage was destroyed by this fungus.

Explanation of Plates III & IV.

III. Typical example of Parsnip canker.

IV. Illustrating formation of growth-cracks and subsequent development of canker: (1) Horizontal cracking; (2) horizontal and vertical cracking; (3) commencement of decay; (4)-(6) further stages of decay and production of canker.

IV.—TAGASASTE AND GACIA.

(*Cytisus* spp.).

J. Hutchinson.

Amongst a donation of Canary Islands' seeds for distribution, Dr. G. V. Perez, of Orotava, Tenerife, has forwarded to Kew several pounds of "Tagasaste," *Cytisus proliferus*, var. *palmensis*,* Christ, "Gacia," *Cytisus stenopetalus*, Christ, and "Gacia blanca," *Cytisus pallidus*, Poir. In various communications to Kew, Dr. Perez has repeatedly urged the importance of Canary Island fodder plants, especially the "Tagasaste," for planting in warm dry countries, such as North and South Africa, Australia and the near east; whilst "Tagasaste" was the subject of a pamphlet by Dr. Perez's father, Dr. V. Perez, and Dr. P. Sagot, published in Paris in 1892. The *Kew Bulletin* for 1891, pp. 239-244, contains a number of extracts from the Kew Reports giving particulars of the distribution of "Tagasaste" seed from Kew to various Colonies, and some of the results therefrom; and Sir Daniel Morris, in the *Kew Bulletin*, 1893, pp. 115-117, gave his own personal observations of the shrub in the Canary Islands. These papers should be read in conjunction with the present notes. Recently Mr. J. H. Maiden has given a comprehensive account of the shrub in the Agricultural Gazette of New South Wales, for October, 1915, pp.

* In the present paper treated as a separate species, *C. palmensis*, Hutchinson.

883-887. In the same journal (p. 888), there is a government recommendation for the encouragement of growing "Fodder Trees as a Resource in Time of Drought," the species recommended being the "Kurrajong" (*Hibiscus heterophyllus*, Vent.), "Mulga" (*Acacia aneura*, F. V. Muell.), "Carob Bean" (*Ceratonia siliqua*, Linn.), "Tree Lucerne" (*Sida rhombifolia*, Linn.), and the native "Salt bush" (*Atriplex campanulata*, Benth.). From what we know of "Tagasaste," it seems probable that it and the other two Cytisi mentioned above might be suitable for inclusion in such a list, as they appear to be particularly adaptable for this purpose. It is true that in some places, notably South Africa* "Tagasaste" is not held in very high esteem, but Dr. Perez thinks that this may be due partly to faulty cultural methods.

For its successful cultivation as a forage plant, two important considerations are strongly emphasised both by Dr. Perez and Mr. Maiden; firstly, that it is useless to allow the shrub to grow without attention, and, secondly, that the taste of animals for the shrub is an acquired one, and they must first of all be taught to eat it, if necessary, by a little starvation. The seeds are very hard and slow in germination, so that before sowing they should be either chipped or soaked in hot water. After about three seasons' growth, the branches should be pruned hard back like a willow, and the young shoots cut off yearly and used for feeding stock. In La Palma, Canary Islands, where "Tagasaste" is native, scarcely anything else is used for feeding animals during the long dry summer season, and the writer has himself seen pack-mules feed greedily on it. In districts that are liable to prolonged periods of drought and consequent serious losses among stock, such as occur in certain parts of Australia, there seems no reason against "Tagasaste" being planted in or as hedges and clipped annually for use during drought when ordinary pastures fail.

As the result of a critical examination of these Canary Island *Cytisi*, it has been found that three distinct species have been confused under the name of *C. proliferus*, Linn. They are distinguished from one another not only by striking differences in the shape of the leaves, and especially by their hairy covering, but each is characteristic of either one or at most two islands of the Canary Archipelago, whilst there is, in addition, a difference in value as fodder as well as constant segregation under separate vernacular names by the peasant people of the Canaries, who are remarkably intelligent about their crops and plants. The extreme endemism of the species of *Cytisus* in separate islands is remarkable, two of the islands, La Palma and Grand Canary, having each two species, and Gomera and Tenerife one species each peculiar to them. This subject, and a detailed account of the Canary species of the genus, may, however, be more suitably dealt with in a separate paper.

The following is a summary of the most obvious differences among the three forage plants mentioned above and of the species with which they have been confused.

* See the South African Agricultural Journal, v. 134 (1913).

**Leaves densely silky-hairy on both surfaces:—*

1. **Cytisus pallidus,** *Poir.*—Laxly leafy; leaflets rather elongate-lanceolate, averaging about 4 cm. long and 7 mm. broad, silky-hairy above, silvery below with long closely appressed hairs; bracteoles as long as or longer than the calyx; calyx-lobes linear-subulate.
   Endemic to La Palma. Native name "Gacia blanca."

2. **Cytisus Perezii,** *Hutchinson,* sp. nov.—Very densely leafy; leaflets distinctly obovate, averaging about 3 cm. long and 1·2 cm. broad, densely clothed with long closely packed silky hairs on both surfaces; bracteoles much shorter than the calyx; calyx-lobes triangular-lanceolate.
   Endemic to the islands of Grand Canary and Hierro. Native name "Escabon de Canaria."

***Leaves densely silky-hairy only on the lower surface, the upper surface glabrous or nearly so:—*

3. **Cytisus proliferus,** *Linn.*—Rather densely leafy; leaflets linear or linear-oblanceolate, averaging about 3 cm. long and 0·5 cm. broad, glabrous or very nearly so above from the beginning, but especially so when mature, closely silky-hairy below.
   Endemic to Tenerife and Gomera. Native name "Escabon."

****Leaves glabrous or thinly pubescent with few short scattered hairs:—*

4. **Cytisus palmensis,** *Hutchinson,* sp. nov.—Laxly leafy; leaflets rather broadly lanceolate, averaging 4·5 cm. long and about 1·2 cm. broad, glabrous or nearly so on both surfaces, but especially so below; racemes shorter than the leaves and few-flowered; bracteoles much shorter than the calyx; calyx-lobes triangular-lanceolate.
   Endemic to La Palma. Native name "Tagasaste."

5. **Cytisus stenopetalus,*** *Christ.*—Laxly leafy; leaflets obovate or obovate-oblanceolate, averaging 2·5 cm. long and 0·8 cm. broad, thinly and shortly pubescent; racemes overtopping the leaves, many-flowered; bracteoles half as long as the calyx; calyx-lobes triangular-lanceolate.
   Endemic to La Palma, Gomera and Hierro. Native name "Gacia."

1. **Cytisus pallidus,** *Poir.* Encycl. Suppl. ii. 442 (1811); Bot. Mag. t. 8578.

* Readily distinguished from *C. maderensis,* Masf., from Madeira, with which it was united by Briquet, by the extremely short cinereous indumentum of the branchlets; in *C. maderensis,* they are densely fulvous-tomentose.

Genista splendens, Webb. in Webb. et Berth. Phyt. Canar. ii. 43 (1836-50). *Teline linifolia*, var. *latifolia*, Webb. l.c. 42; Pitard et Proust, Fl. Canar. 151 (1908). *Cytisus linifolius*, var. *pallidus*, Briq. Les Cytis. des Alpes Marit. 140 (1894).

Canary Islands. Palma: Barranco del Rio, 1843, *Webb*; cliffs above Tenerra, Caldera, *Sprague and Hutchinson* 466; cultivated by *Dr. G. V. Perez* at the Villa Orotava, Tenerife.

This is reputed to be a valuable forage crop (*vide* Dr. Perez), and is known to the peasants of La Palma as "Gacia blanca"; the local name in Webb's time was "Herdanera." It is, however, neither so good nor so vigorous a forage plant as "Gacia." *C. stenopetalus.*

2. **Cytisus Perezii,** *Hutchinson*, sp. nov.; *C. proliferus*, var. *Canariæ*, Christ in Engl. Bot. Jahrb. ix. 120 (1887) var. *laxiflorus*, O. Kuntze, Revis. Gen. Plant. i. 178 (1891).

Frutex vel arbor parva, multe ramosa; rami breves, subdense foliati, dense molliter tomentosi. *Folia* brevissime petiolata, trifoliolata; foliola obovata vel oblanceolata-obovata, ad apicem breviter mucronatum rotundata, ad basin cuneata, 2-3·5 cm. longa, 1-1·5 cm. lata, tenuiter chartacea, utrinque pilis nitidis sericeis appressis permanente dense obtecta; petioli usque ad 1 cm. longi, molliter tomentosi. *Flores* in ramulos breves axillares conferti; pedicelli usque ad 1·5 cm. longi, nutantes, molliter fulvo-tomentosi. *Calyx* circiter 1·3 cm. longus, extra dense fulvo-villosus. *Vexillum* orbiculare, breviter unguiculatum, circiter 1·8 cm. longum et 1·3 cm. latum, apice leviter emarginatum, dorso sericeo-pilosum; alae oblique oblongae vel semilunares, apice rotundatae, uno latere undulate auriculatae, ungue 5 mm. longo glabro, lamina 1·5 cm. longa latere inferiore breviter ciliata; carinae petala aliis simillima sed minora et longiore auriculata. *Tubus staminalis* 1·3 cm. longus. *Ovarium* appresse villosum, stylo curvato basin versus parce pubescente. *Fructus* non visus.

Canary Islands. Grand Canary: Firgas, *O. Kuntze*; without definite locality, *Bourgeau*; *Lowe*; *Finlay*.

Hierro: About a mile from Valverde, towards the port, *Lowe* 70; above the church at El Golfo, *Lowe* 70.

Vernacular "Escabon de Canaria."

It gives the writer much pleasure to associate with this species the name of Dr. G. V. Perez, who has provided a liberal supply of his cultivated Canary Islands' Cytisi, and whose kindness to the writer and his companion during their visit to Tenerife will not be readily forgotten.

3. **Cytisus proliferus,** *Linn. f.* Suppl. 328 (1781). *C. proliferus*, vars. *angustifolius* et *nanus*, O. Kuntze, Revis. Gen. Plant. i. 178 (1891).

Canary Islands. Gomera: El Monte, Hermigua, *Lowe* 128.

Tenerife: El Monte Perexil, above Agua Mansa, 2000 m., *Lowe* 9; below Pedro-Gil, 1600 m., tree 20-25 ft. on bare slopes, *Dinn* 157; Santiago, *O. Kuntze*; Barranco de Montijo, 1000-2000 m., *Mann* 2514; "Mountain woods," *Masson* (type); *H. F. Talbot*; *Bourgeau* 51; 1306.

Vernacular "Escabon."

The type specimen was collected in 1778 by Francis Masson, the first collector sent out by Kew, and is at the Natural History Museum, South Kensington.

4. **Cytisus palmensis,** *Hutchinson*, sp. nov.; *C. proliferus*, var. *palmensis*, Christ in Engl. Bot. Jahrb. ix. 120 (1887).

Frutex laxe ramosus, usque ad 10 m. altus; rami elongati, foliati, breviter incano-tomentosi. *Folia* petiolata, trifoliata; foliola lanceolata, utrinque acuta, apice mucronata, 3-5 cm. longa, 0·7-1·4 cm. lata, tenuiter chartacea, supra primum debile et brevissime pubescentia, demum glabra vel subglabra, infra brevissime pubescentia; petioli 1-1·5 cm. longi, basin versus complanati, molliter tomentosi. *Flores* albi, in ramos breves axillares apice foliatos 3-4-natos dispositi; pedicelli graciles, 1-1·5 cm. longi, pilis longis et brevibus dense tomentosi. *Calyx* circiter 1 cm. longus, extra molliter pubescens, labio superiore breviter et acute bilobato, inferiore parum longiore acuto. *Vexillum* orbiculari-obovatum, breviter unguiculatum, fere 2 cm. longum et 1·4 cm. latum, apice minute emarginatum, dorso apicem versus leviter pubescens; alae oblique oblongae, apice rotundatae, uno latere auriculatae, ungue ciliato 5 mm. longo, lamina 1·5 cm. longa basin versus minute ciliata; carinae petala aliis simillima sed paullo breviora. *Tubus staminalis* 1 cm. longus. *Ovarium* pilosum, stylo curvato parce pubescente. *Fructus* oblongus, 4-4·5 cm. longus, 1-1·3 cm. latus, subappresse pubescens. *Semina* oblongo-ellipsoidea, 5 mm. longa, nigra, nitida, basi arillo crasso cupulare 1·75 mm. alto crenulato circumdata.

Canary Islands. La Palma: Borders of woods above the Barranco del Carmen, *Christ*; Dolores, *Christ*; La Banda, above Argual, at the foot of the cumbre towards the Caldera, *Lowe*; Lomo de Tagasaste, Caldera, *Sprague* and *Hutchinson* 436.

Vernacular "Tagasaste."

This plant is evidently confined in a wild state to the island of Palma, where it is extensively cultivated as a fodder plant (*vide supra*).

5. **C. stenopetalus,** *Christ* in Engl. Bot. Jahrb. ix. 162 (1887); Pitard et Proust, Fl. Canar. 151. *Teline stenopetala*, Webb. in Webb et Berth. Phyt. Canar. ii. 37 (1836-50). *Genista stenopetala*. Webb. l.c. t. 45. *Telinaria stenopetala*, Presl. Bot. Bemerk. 49 (1844). *Cytisus maderensis*, Briq. Les Cytis. des Alpes Marit. 137, partim (1894), non Masf.

Canary Islands. La Palma: Barranco del Rio, *Webb*; in the woods at El Monte de Barlovento, May, 1858, *Lowe* 342; between Garafia and Barlovento, Feb., 1888, *O. Kuntze*.

Gomera: El Monte, Hermigua, Apr. 1861, *Lowe* 117.

Hierro: Monte de Savinosa, June, 1845, *Bourgeau* 90; El Golfo, May 1855, *Perraudiere*; *Lowe* 202.

Vernacular "Gacia."

Briquet (l.c.) says this species occurs in the Cape Verde Islands, but the writer has not seen any specimens from there.

VI.—SPARTINA AND COAST EROSION.*

Ida M. Roper.

An experiment is being tried in North Somerset to fight against the constant erosion of the coast line in the Bristol Channel where the conditions render it entirely different from what has been undertaken hitherto in other parts.

Here the spring tides rise regularly to 36 ft., and deposit on each occasion a considerable amount of mud right up to the limit of high water, but, on the other hand, scour away equally large quantities when the waves beat on the coast under the pressure of winter gales.

The Bristol Channel is full of long stretches of mud flats with deep water channels running amongst them. As the tides ebb and flow the edges of these flats are continually changed, and this applies equally to the long slopes of mud which are exposed at low water on the actual shore of the Channel. When these shore flats become lowered by the removal of their surface, the up-rushing tides, moving at times at five knots an hour over the ground, reach with increased force the earth-banks, which stand perpendicularly above the mud in varying heights from 2-20 ft.

This force of the tide eats into the bottom of the earth-bank, and with still more effect when the incoming tide is driven forward by a gale, with the result that the whole bank topples down on to the mud, and the tide can in this way get a few feet further inland.

This erosion has been going on for centuries; it has been slightly arrested by the coast lands rising a few feet in some parts of the Channel north of the Holm Islands, which stand across the Channel between Cardiff and Weston-super-Mare, but in other parts of the same stretch the destruction has been continuous, although at varying rates.

Nearly 150 years ago in this district the owners of the flats from Berkeley to the River Avon, with the help of Government, combined together, and went to the expense of building an earthen, and in some parts a stone bank some 10 ft. high all along the edge of the channel, a little distance above high-water mark. In this way they prevented specially high tides in combination with strong gales from washing away the surface of the neighbouring land, and they followed up this gain by a careful system of drainage, which enabled them to sow grass and convert the hitherto useless marsh into valuable pasturage.

In course of years similar extensive works were carried out both higher up the Severn and lower down as far as Bridgwater, at those parts where such sea-banks could give protection to the land behind.

This system of guarding the land answered very well, although a certain amount of ground between the sea-bank and high-water mark was being constantly eaten away by exceptionally heavy

* For previous accounts of *Spartina*, see *Kew Bull.* 1907, p. 190; *Stapf* in Gard. Chron., ser. 3, xliii. (1908), p. 33, and in Proceed. Bournemouth Nat. Sc. Soc. v. (1914), p. 76–82, pl. i–iii.

Sherring in Proceed. Bournemouth Nat. Sc. Soc. iv. (1913), p. 49, pl. i, ii.

weather. But that had been foreseen, and the land being of little value for feeding purposes, because of the large quantity of salt contained in the soil, the owners allowed it to go on unchecked. In other parts of the kingdom, however, the losses of valuable land from similar causes had become so serious that about 1907 Government appointed a Royal Commission to enquire into the facts and to suggest remedies. It was then urged that much good might be done to lessen, and possibly to stop, coast erosion by planting certain sand- and mud-binding plants, which might, by their numerous roots, bind together either the sand or mud and prevent erosion by the waves, and later on, by the great increase in their growth, raise the level of the ground gradually out of the reach of all such scouring action.

Spartina was among the grasses recommended to be planted as specially suitable where soft mud forms the only protection against erosion for the adjoining earth-banks; and as these are the conditions met with on the shores of the Severn in North Somerset, the planting of this particular grass became of special interest to the landowners of the neighbourhood.

Spartina Townsendi, the hybrid between *S. stricta* and *S. alterniflora*, which now covers thousands of acres of mud-flats in Southampton Water and Poole Harbour, is the one which has been planted in North Somerset. It is a vigorous stiff grass, reaching usually 2½ ft. in height, with rigid leaves, long and pointed, standing off at an angle of about 60°. These rigid outstanding leaves are characteristic features, and easily distinguish it from the other two kinds. The stems and leaves are coloured a bright green when young, but turn in autumn to a brown hue with a beautiful golden sheen resembling ripe corn. On top of the solitary stem are the flowers in a stiff, branched spike growing at one side only of each branchlet. The spreading of *Spartina* to new areas and distant parts is mainly due to the dispersal of seeds; but as soon as it has established itself in an area, the covering over of the area by the closing up of originally isolated patches proceeds much more by stolons than by the interpolation of seedlings, chiefly because seeding is very irregular, and in some years almost nil. The underground stolons root at the nodes, and give rise to new plants. This method of growth causes the grass to form circular tufts, which go on increasing to many feet in diameter, until the spreading brings them in contact with other similar tufts, when the two join, and so produce large masses of closely interwoven roots to bind the mud together. Thus, in a few years regular fields or " meadows " of the grass appear where the mud had been in undisputed possession.

It will be observed that soft mud has played a very important part in the spread of the grass, because it is able from its nature to flourish in such mud when there is not too much sand present, and where practically no other plants are able to establish themselves in competition. It cannot grow apparently everywhere where such soft mud exists, as the plant will not survive being constantly covered by salt water; it will flourish when covered

by $2\frac{1}{2}$ ft. of water at ordinary high tides, but its growth appears to be checked nearly completely if the depth exceeds 3 ft., whilst in shallower waters nearer the land it will put up with every hardship. Hitherto the growth of this particular species in England has been in quiet waters away from strong tides and the beating of heavy waves, and it may prove that such backwaters and river estuaries are its abiding home.

It will thus be evident that a plentiful growth of *Spartina Townsendi* on a bare expanse of soft mud daily washed by a moderate tide is capable of converting quickly such mud-flats into dry land and raising them above the level of ordinary tides. Should it prove capable of doing similar useful work in the presence of strong tides, a great help will have been obtained to check the constant washing away of muddy shores, and the growth of the grass would in course of time form a raised barrier protecting the adjoining earth-banks from erosion by the waves.

This is the experiment that is being tried on the coast about three miles south-west of Clevedon, North Somerset, and there *Spartina Townsendi* has been deliberately planted to test whether it be possible to overcome the strong tidal currents of the Severn, and the very heavy waves which beat upon the shore whenever the prevalent south-west winds blow strongly.

Special visits have been made to the spot this autumn to examine the results, and it is very interesting to find that the grass appears to have established itself with success, although the conditions are so different from those of the quiet estuaries of the English Channel.

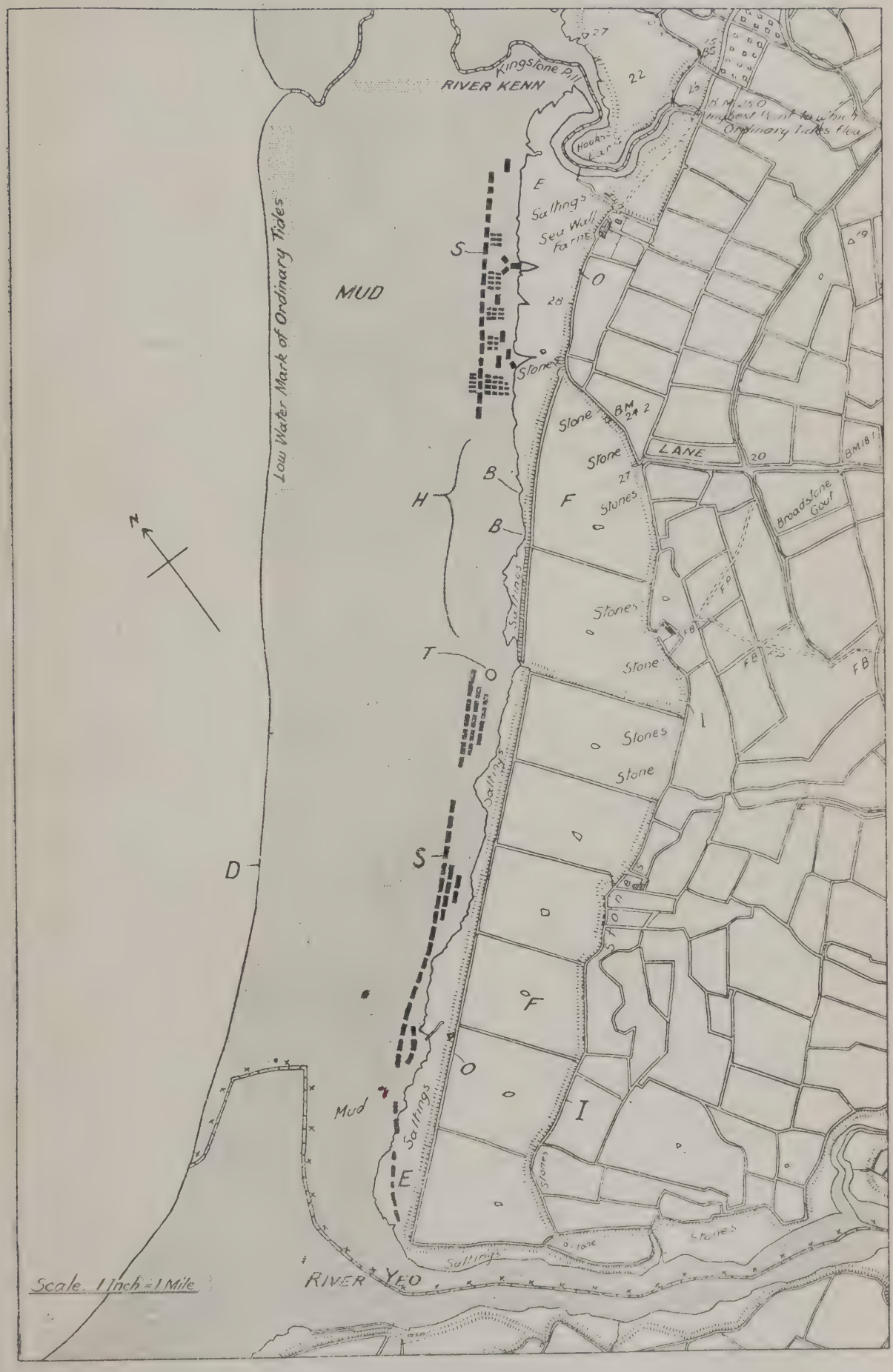
It may be well to mention a few particulars of the conditions prevailing on the land below Clevedon between the estuaries of the rivers Kenn and Yeo, and the accompanying map will make these clear.

Inland there are fields (F), approached by a lane, protected by two lines of sea banks (O, I), the two barriers being built to make sure that if the front one is broken through by the force of the strong waves that beat in at that particular part, the water shall not be free to flood hundreds of acres of grassland that lie behind at only a few feet above the level of high-water mark.

Outside the front sea-bank is a flat stretch of grassland, called saltings or salt-marshes (E), in parts raised some 20 ft. straight up above the mud, and in others much less; very narrow in their width, and constantly becoming narrower by the erosion of the waves and tide. In fact, it looks as if all this salting would have disappeared by this time had not the authorities put in stretches of stone-facing to the earth-bank at the weakest spots.

By the River Yeo, at the south-west end, the erosion since the Ordnance map was issued in 1904, has been particularly severe, so that what is there represented as saltings is now soft mud about 3 ft. lower and reaching nearly to the sea-bank, with *Spartina* growing upon it some 30 yds. out to sea.

Seaward there is a stretch of soft sticky mud some 600 yds. in width, extending to low-water mark, and the object of the experiment of planting *Spartina* was to find out if it would grow on the mud in sufficient masses to check the force of the waves


Kingstone Pill
RIVER KENN
Low Water Mark of Ordinary Tides
MUD
Hooks-kerr
Salting's
Sea Wall
Stone
Stones
BM 24.2
LANE
BM 18.1
Broadstone Gout
Salting
Mud
RIVER YEO
Scale. 1 Inch = 1 Mile
N
E
F
O
S
B
H
T
D
I
L
FB

from further eating away the saltings, already so nearly destroyed.

It is apparent at once that success is likely to attend the trial. There are sure signs of a vigorous and healthy growth of the grass, as the dots on the mud (S) show that it has already obtained a good foothold. The circular tufts are becoming much larger, and, whilst coming close together in some parts, are in others arranging themselves into miniature meadows across the run of the tide.

The number of tufts amount to several thousands, and as the mud is continuous into the bank they can send up new plants by means of their far-reaching runners or stolons. It is noticeable that the outermost tufts run in a nearly straight line, and this probably marks the spot where the mud is covered at ordinary tides by 2 to 3 ft. of water, and left dry again after a short time of immersion. The distance of this line is from 50 to 100 yds. out from the sea-bank (O). At one part, about one-third of a mile in length, no tufts of grass appear to have taken root, and this is no doubt a spot where the beating of the waves during rough weather is particularly strong, since the sea-bank on the shore opposite this stretch has been breached recently by heavy waves (B), and the path along it cannot at present be used.

This arrangement of the *Spartina* tufts in lines parallel with the shore is very noticeable at present in three small bights, where the rush of tide may be slightly checked by the intervening headlands, and a similar arrangement has been observed to occur in the quieter waters of the English Channel; but what is particularly interesting is the arrangement at the outermost belt, and it may be that the depth of mud rather than the height of the tide is the determining factor for the vigorous growth of the grass.

Four years ago the landowner, Mr. A. E. Clothier, of Keynsham, obtained a quantity of *Spartina Townsendi* from Hayling Island, which he had split up into one thousand small tufts consisting of two or three plants in each, and these were planted by the Warden one yard apart in a straight line in the mud close against the upright earth-bank of the saltings. The waves, however, promptly floated them all out, and deposited them 40 or 50 yds. to seaward. There most of them fortunately took root, and gradually settled down in a more or less straight line opposite the place where they were originally planted, with many of them shifted nearly half-a-mile northwards.

It was further stated that in about the year 1900 there was over 6 ft. of mud on this shore lying upon a layer of peat 4 in. thick, under which is found a bed of white clay, but by 1917 the mud was only 6 in. deep on the same spots (T). It would seem that on such thin mud close into the bank it was not a good place to plant the *Spartina*, but it is remarkable and novel that the tufts should be able to re-arrange themselves some way further out where the conditions were more favourable.

To illustrate further the scouring away of the shore it was learnt that in the three bights mentioned the earth-banks had been faced with carefully placed stonework, which for some years

past had to be constantly extended in length, and more often had to be underpinned with additional stones. Only this past summer at one spot 1½ ft. of underpinning had been put in, and within six weeks the operation had to be repeated, because the scour had taken away the supporting mud beneath for a depth of some additional 18 in.

The little tufts have increased greatly in number and have grown remarkably in size, many of them, after four years' growth, being more than one yard in diameter and forming many offshoots. Scarcely any of the tufts, however, have so far had time to grow sufficiently large actually to join together, and all of them in their present position are covered by a foot or two of water at each tide for one or two hours. If the present rate of growth continues with equal rapidity the mud will soon be clothed with a dense vegetation, and, to judge by the inspection of one of the present tufts, the hitherto soft mud will afford sufficient support for a man to stand upon the ground without making more than a footmark.

The numerous stems keep back amongst them during each immersion a small quantity of mud and silt, which serves to raise the ground, a little being held by the roots and stems, and at the same time a certain amount of sand brought in with the tides is left on top, which still further solidifies the mud.

Four years is a very short time to watch such changes, and it will be interesting to see whether *Spartina* can hold its own against the force of the waves, and increase in sufficient quantity to render their action of small account after they have travelled across the thick growth to the foot of the saltings. Should the force of the waves be broken at this spot, the experiment will have been a success, and it may be anticipated that a further growth of the grass will line the foreshore with a stretch of firm ground that will protect the sea-bank more effectually than was done by the original saltings when they were left outside for that purpose.

VI.—MISCELLANEOUS NOTES.

Worthington G. Smith.—It is with much regret that we record the death of Worthington G. Smith, which occurred at Dunstable on 27th October, 1917. To readers of the *Gardeners' Chronicle*, Mr. Smith was best known as a botanical artist, and the clear, forcible illustrations initialed with the familiar "W. G. S." appeared regularly for a period exceeding 40 years. He was, however, in addition, an antiquarian, and a well-known mycologist. His drawings of plants were characterised by firmness and attention to detail, and, as may be seen from the magnificent series of coloured drawings in the public galleries of the British Museum, his fungus drawings were of the highest order. Though not in very close touch with Kew, he was keenly interested in the new British fungi described by the Herbarium staff, and always anxious to learn the distinguishing features with

a view to obtaining a figure for his own series of drawings of British fungi.

Worthington Smith was born in 1835, and was a contemporary of Berkeley and Cooke; by his death, therefore, mycologists are deprived of a most interesting link with the past. His principal published works were:—*Diseases of Farm and Garden Crops* (1884), a supplementary volume to Berkeley's *Outline of British Fungi* (1891), *Man, the Primeval Savage*, and the well-known and useful *Synopsis of British Basidiomycetes* (1911). Amongst other awards received for his work as an artist was the Gold Medal of the Royal Horticultural Society, and the Silver Medal of the R.H.S. of Ireland. In 1865 he was awarded the Knightian Medal of the former society for his researches on Potato Blight; the results of this work, however, have not been altogether accepted by later botanists. Worthington Smith was the first freeman of Dunstable, and was President of the British Mycological Society in 1903. He was awarded a Civil List Pension in 1902 for his services to archaeology and botanical illustration. A. D. C.

Edward John Woodhouse, Lieut.—We record with regret the death, from wounds received in action in France, of Lieut. E. J. Woodhouse, M.A., F.L.S., Economic Botanist and Principal of the Agricultural College, Sabou, Bihar and Orissa, which occurred at a Casualty Clearing Station in France, on December 18th, 1917, aged 33.

In October, 1907, he was appointed Economic Botanist to the Government of Bengal, and proceeded at once to India. After three years' work there he was made Principal of the Agricultural College of Bihar and Orissa, retaining his other appointment. By a successful invention for the treatment of a pest in his province, he saved his Government in one year between four and five lakhs of rupees. At the outbreak of war he was a captain in the Bihar Light Horse. After repeated applications he was allowed to join the Indian Army Reserve of Officers, and in February, 1915, was attached to a cavalry regiment on the N.W. Frontier. In the following July he went to France, where he was attached to another cavalry regiment and became signalling officer, acting adjutant, and officiating squadron commander.

A. H. Hildebrand.—It is with much regret that we learn of the death of Mr. Arthur Hedding Hildebrand, C.I.E., which was announced in *The Times*, of January 7th. Though best known for his administrative work in Burma, where he spent more than 30 years of his life, and where, between the years 1891 and 1902 he was Superintendent and Political Officer of the Southern Shan States, he will be remembered in the horticultural world as the introducer of several plants which have been of more than ordinary interest. These, in most cases, were sent to Kew, with which Mr. Hildebrand commenced to correspond in 1891 in consequence of a request having been sent to him by the Director for seeds of the remarkable *Lonicera Hildebrandiana*, Collet & Hemsl., which had been described shortly before. Mr.

Hildebrand experienced some difficulty in procuring seeds of this plant owing to the fact that its fruits, which are nearly as large as a walnut and have a sweet pulp, are eaten by rats, squirrels and birds. However, he at length succeeded in getting some seeds which were received at Kew in September, 1892, but these failed to germinate. From a consignment received in September, 1893, some plants were raised, and in January, 1894, a Wardian case containing 49 seedlings of the *Lonicera* reached Kew, from which some were distributed to various establishments, including the Royal Botanic Gardens, Glasnevin, where the plant first flowered in August, 1898. In 1899 a plant flowered in the Temperate House at Kew, and material obtained from this was used in the preparation of the plate in the *Botanical Magazine* (t. 7677). *Lonicera Hildebrandiana* was afterwards discovered at Mengtze and Szemao in Yunnan, by Mr. Augustine Henry, but in the Chinese specimens the corolla is rather shorter than in the Burmese. It is only in very favoured localities, such as Cornwall, that this honeysuckle will thrive out-of-doors in these islands, and only a greenhouse of large dimensions will accommodate so robust a grower. It is, therefore, never likely to become a popular plant. This remark applies still more forcibly to *Rosa gigantea*, Collett (*Bot. Mag.* t. 7972), which, though introduced into this country some years before Mr. Hildebrand commenced his correspondence with Kew, was the subject of some interesting comments in his letters. We learn from these that in Burma the rose sometimes forms a bole as thick as a man's thigh, and its stems overtop trees 60 to 80 ft. high, when, its branches hanging from the tree-tops, it blossoms profusely, its flowers appearing as a sheet of white and filling the air around with a delightful fragrance.

Amongst other plants sent to Kew by Mr. Hildebrand were *Bulbophyllum comosum*, Collett & Hemsl. (*Bot. Mag.* t. 7283), originally introduced into this country by Colonel Sir H. Collett in 1889; *Aeschynanthus Hildebrandii*, Hemsl. (*Bot. Mag.* t. 7365), and *Orchis monophylla*, Collett & Hemsl. (*Bot. Mag.* t. 7601). Perhaps his best introduction was *Dendrobium Hildebrandii*, Rolfe (*Bot. Mag.* t. 7453), which he sent to Messrs. Hugh Low & Co., of Clapton, who forwarded plants to Kew. This is a handsome and remarkably floriferous species allied to *D. tortile*, Lindl., with light yellow flowers, or, in the variety *oculatum*, with two maroon blotches on the disc of the lip. It is a parent of several interesting hybrids, including *D. Elwesii*, *D. Ellisii* and *D. Haywoodiae*.

In addition to various other plants Mr. Hildebrand sent to Kew seeds and a large number of bulbs of *Lilium sulphureum*, Baker, *L. Lowii*, Baker, and *L. Bakerianum*, Hemsl. & Collett. He was anxious to experiment in Burma with the cultivation of English garden roses and strawberries and a collection of plants of the former and seeds of several kinds of strawberries were sent to him from Kew.

Mr. Hildebrand retired in March, 1902, and returned to his English home at Devizes, Wiltshire. He died at Puddletown, near Dorchester, at the age of 65. S. A. S.

Additions to Gardens.—The war continues to affect the exchange, etc., between Kew and other botanical establishments. Of the comparatively few consignments of material sent from Kew to oversea institutions a few were lost in transit. This was also the fate of some consignments from abroad intended for Kew. Notwithstanding these difficulties, many consignments of seeds and a few living plants were received from botanical and other institutions all over the world. The principal receipts during the year were:—

Botanic Gardens and other institutions:

Loanda, Angola—Seeds of Palms and various plants of economic interest.

Arnold Arboretum—Many packets of seeds.

South African Department of Agriculture, Pretoria—Various seeds, tubers and plants, including Teff grass (*Eragrostis abyssinica*).

Giza, Department of Horticulture, Cairo—Various seeds, including *Hyoscyamus muticus*, *Ilex paraguayensis* and *Hyphaene thebaica*.

Dunedin Botanic Garden—Seeds of Celmisias and other New Zealand plants.

Hong Kong Botanic Garden—Seeds of *Rhodoleia championi*, *Tutcheria spectabilis*, *Strychnos angustiflora*, and *Momordica cochinchinensis*.

United States Department of Agriculture, Washington—Various trees and shrubs.

Singapore Botanic Garden—Various seeds, including *Hyphaene indica*, *Styrax benzoin*.

Greenwich Park (Mr. T. Hay)—*Gentiana Farreri*, *Meconopsis decora*, etc.

Honolulu, Board of Agriculture and Forestry—Seeds of Palms, etc.

Calcutta Royal Botanic Garden—Various seeds.

Khartoum, Department of Agriculture and Forests—Seeds of *Hyoscyamus muticus*.

Trinity College Botanic Garden, Dublin—*Amorphophallus Kerrii*.

National Botanic Garden, Kirstenbosch, Cape Town—Seeds of South African plants.

Trinidad Royal Botanic Garden—Cacti from Patos Island.

Director Agricultural and Commercial Services, Saigon, Cochin-China—Seeds of *Strychnos Nux-vomica* from wild plants in Cochin-China.

Uganda Protectorate, Forestry Department—Seeds of *Carapa grandiflora*, etc.

Dominica Botanic Garden—Tubers of Yams and Aroids.

Royal Botanic Garden, Edinburgh—New species of *Primula* from China.

Kumaun Botanic Garden—*Anoectochilus* sp.

Receipts from other sources included the following:—

Mr. F. Nutter Cox, San José, Costa Rica—Seeds of an indigenous cotton, believed to be a new species.

Mr. M. T. Dawe, Director of Agriculture, Colombia—Seeds of rare and new plants, including *Befaria* sp. and *Cactaceae*.

Mr. H. J. Elwes, Colesborne—Various plants and seeds.

Miss A. Balfour—Seeds of *Eucalyptus whittingehamensis*.

Countess of Selborne—Seeds of *Meconopsis* from Sikkim.

Messrs. Singlehurst and Co.—Seeds of *Cybistax antisyphilitica* from Bolivia.

Mr. J. C. Williams, Caerhays—Chinese Rhododendrons and Primulas.

Dr. G. V. Perez, Teneriffe—Seeds of Palms, Pines, Echiums and Cytisi for distribution.

Prof. A. Henry—Seeds of *Picea sitchensis*, *Larix alaskensis* and *Cedrus brevifolia*.

Mr. N. E. Brown, Kew—Stapelias, Mesembryanthemums, etc.

Mr. A. Jackson, H.B.M. Consul, Madrid—Seeds of five species of Junipers from Madrid and Valencia, for distribution. Collected by Mr. Alfred Martinez, of the Forestry Board, Madrid, and Mr. Rafael Janini, Agricultural Engineer, Valencia.

Hon. Vicary Gibbs, Aldenham—Various trees and shrubs.

Capt. J. Bush, Chatham—*Pelargonium Cotyledonis* from St. Helena.

Mr. R. Vallentin, Falmouth—Ferns from the Falkland Islands.

M. Vilmorin, Paris—Hybrid *Columnea*.

Mr. C. U. Stuart, Alaska—Seeds of native shrubs, etc.

Mr. H. Clinton Baker, Bayfordbury—Conifers.

Mr. W. Cooke, Colombia—Seeds of *Posoqueria Cookei*, etc.

Mrs. Longstaff, Wimbledon—Seeds collected in Yassin, etc.

Mr. E. H. Wilding, Stoke Poges—*Rhododendron maximum*.

Mr. W. Greenwood, New South Wales—Various seeds.

Mr. R. H. Beamish, Cork—*Corylus thibetica*.

Miss E. Willmott—Paeonias, etc.

Mr. W. R. Dykes, Godalming—*Iris Wattii*.

Mr. P. D. Williams, St. Keverne—*Primula Maclareni*.

Mr. R. Farrer, Lancaster—Collection of Chinese Plants (52 species).

Mr. W. A. Milner, Sheffield—*Primula Reidii*.

Mr. S. W. Damon, Argentine—Seeds of *Ilex paraguayensis* var.

Mr. A. C. Butter, Stellenbosch—Seeds of *Telfaria pedata*.

Miss P. Wake, Northampton—A large *Platycerium*.

Lieut.-Col. F. R. S. Balfour, Dawyck, N.B.—Various seeds.

Mr. A. E. Felton, West Falkland—Seeds of *Calandrinia Feltoni*.

Prof. O. Beccari—Seeds of *Copernicia australis*.

Sir E. G. Loder, Bt., Leonardslee—Various trees and shrubs.

Capt. G. H. Johnston, Trewithan—Seeds and bulbs from Palestine.

Mr. G. W. E. Loder, Ardingly—Various trees and shrubs.

Mr. C. D. Graham, Kildare—Seeds from Macedonia.
Mr. G. Elisha, Canonbury Park—Mesembryanthemums.
Mr. T. H. Burroughs, Stamford—Various trees and shrubs.
Prof. J. H. Wilson, St. Andrews—Hybrid Passifloras and Begonias.
Mr. A. Monk, New Jersey—Seeds of *Gentiana crinita.*
Sir F. Crisp, Bt., Henley—Various economic plants and palms.
Major Howard, Richmond—Seeds from Kilamatende, East Africa.

Among the purchases made were specimen Filmy Ferns, from Mrs. Waterhouse, Halifax, and seeds of *Pouteria suavis* and *Ilex paraguayensis* from Mr. E. Frosio, Uruguay.

Surplus plants were distributed to various botanic gardens and public parks, and there was the usual distribution of seeds that had been saved during the year from the cultivated plants in the gardens. The total number of packages thus distributed was 966 hardy herbaceous, and 689 hardy trees and shrubs.

The most important of the seeds specially distributed were those of *Hyoscyamus muticus,* which yield Hyoscyamine of commerce; *Ilex paraguayensis,* which yield Paraguay tea; *Clematis Stanleyi; Pouteria suavis;* "Teff", (*Eragrostis abyssinica*); *Befaria* sp. from Sierra Nevada; Juniper seeds from Spain and seeds of Cytisi and *Pinus canariensis* from Teneriffe.

A number of plants raised for British Military Cemeteries in France, including 250 Eucalypti, Canadian Maples, and other trees and shrubs were sent to the Director, Graves Registration and Enquiries, G.H.Q., France.

During the year a number of nursery borders and some flower beds in the public grounds were devoted to the cultivation of vegetables, such as potatoes, turnips, parsnips, cauliflowers, cabbages, carrots and leeks.

Arboretum.—The difficulties arising from the shortage of labour, to which reference was made a year ago, have, as was only to be expected in present circumstances, increased during the past twelvemonths. As regards cleanliness and order they have indeed proved cumulative, owing to the impossibility of preventing the seeding of weeds during the last two summers. But weeds, however unpleasant and unsightly they appear, may we hope, be regarded as a temporary evil. Our chief aim must be to keep intact the magnificent collections of living plants which have been got together with such an expenditure of time, labour and money.

The grass on many of the lawns, in normal times kept closely mown, was left to grow, thereby contributing to the large stack of excellent hay which, in spite of the dryness of the early summer, was secured.

Little damage has been done by storm during the past year as compared with 1916, but two fine trees were destroyed by lightning—one a large sweet chestnut near the North Gallery, the other a common oak near the Azalea Garden. The first was barked so thoroughly that it died by autumn, whilst the trunk

of the latter was split to the very base. A spreading beech of huge dimensions near the Oxenhouse Gate was so badly wrecked by wind that it had to be removed. It was no doubt one of the comparatively few beeches that remain of the Richmond Gardens of Queen Caroline's time.

The Chinese barberries introduced by Messrs. Wilson and Forrest are so numerous and have grown so well that it has been found necessary to enlarge the area devoted to the Natural Family to which they belong. Fresh ground has therefore been taken for them on the northern slope of the Flagstaff Mound. These new barberries are proving very ornamental in their fruits, and will certainly be valuable acquisitions among hardy trees and shrubs.

The semi-oval plot of ground on the north side of King William's Temple has been re-laid out. It is proposed to plant here shrubs of exceptional interest or delicate growth. In many Natural Families there are species too small or not sufficiently robust to hold their own against the average run of their allies—such for instance as *Pachystima Canbyi*, *Ilex Mariesii*, *Rhododendron Williamsianum* and *R. flavidum* These, and others of a similar class, can here be given special care and kept free from the encroachment of greedy neighbours.

At the request of the military authorities the Assistant Curator has visited parts of the coast to advise on the planting of sand dunes and for purposes of camouflage; also as regards planting for shelter and ornament near new residential quarters being erected by the Admiralty.

Very few additions of living trees and shrubs have been made, but acknowledgments are due to several amateurs who have contributed new species, especially to Mr. J. C. Williams, the Hon. Vicary Gibbs, and Mr. Reginald Farrer. One consignment only has been received from overseas, viz., some new plants, mostly of Chinese origin, from the U.S. Dept. of Agriculture.

Donations of trees and shrubs have been made to the following public institutions:—Unemployment Insurance Buildings, Kew; Queen Alexandra's R.C. Hospital, Glengariff; R.F.C. Aircraft Park, Bristol; British Military Cemeteries in France.

The following new rhododendrons have flowered for the first time at Kew:—*R. adenopodum*, *R. hippophaeoides*, *R. oleifolium*, *R. polifolium*, *R. prostratum*, and *R. Sargentianum*. The remarkably late flowering *R. auriculatum*, which first blossomed at Kew in 1916, did so again in July, 1917, and much more freely than before. W. J. B.

Museums.—In the past year the additions to the permanent collections have been few in number, consequently the duplicate material for distribution has been limited. A large number of miscellaneous products have been received for determination from Government Departments, scientific institutions, commercial firms and private individuals, and much general information has been supplied in this direction. Many of the

enquiries dealt with were of a confidential character; the chief products not confidential as to which information has been given have been foods, food grains, oil seeds, medicinal plants, timbers, fibres, and dyes. Considerable progress has been made in generally improving the collections, and over two thousand freshly-printed labels have been attached to the collections in Museum No. 1. The buildings that are closed, due to depletion of the staff, have in all cases been made available to visitors desiring to examine the collections for special purposes or for general study. J. M. H.

Presentations to Museums.—The following miscellaneous specimens have been received in addition to those previously recorded in the *Bulletin*:—

Crown Agents for the Colonies.—Sample of Cocoa from the Cameroons.

Director, Botanic Gardens, Singapore.—Sections of wood of *Rhodamnia trinervia*, *Cupania pallidula* and *Elaeocarpus Hullettii*.

Dr. Perez, Santa Ursula, Tenerife.—Roots and pieces of trunks of *Convolvulus scoparius*.

Mr. M. T. Dawe, Director of Agriculture, Colombia.—Specimens of native wood carving, seeds of Ivory Palm (*Phytelephas macrocarpa*), bark and resin of *Cercedium spinosum*, pods of Divi Divi (*Caesalpinia coriaria*), etc.

Mr. J. S. Gamble, F.R.S., East Liss, Hants.—Seven small samples of Mahogany.

Mr. S. W. Damon, Orán, Argentine.—Pods of Algarrobo blanco and of Algarrobo negro (*Prosopis juliflora*, var.), fruits of Mistol (*Zizyphus Mistol*), also fruits and seeds of Chanar (*Gourleia decorticans*).

Private C. C. Pemberton, Canadian Reserve Battalion.—Twelve photographs of root and branch grafting in British Columbia.

Mr. G. M. Ryan, F.L.S.—Series of photographs of the Mahwa tree (*Bassia latifolia*), India.

H.M. Consul, Costa Rica.—Fruits of the Balsa tree (*Ochroma lagopsus*).

Mr. Cecil Brown, Kew.—Gnarl on *Cedrus Libani*.

Sir E. G. Loder, Bart., Horsham, Sussex.—Cluster of cones of *Pinus*.

Mr. T. Drewry, Forest Gate, Essex.—Section of a pile of Ballah wood (*Shorea collina*?) bored by teredo, drawn up in Keppel Harbour, Singapore, 1907.

Mr. E. R. Pratt, Downham, Norfolk.—Planks of *Abies Nordmanniana*, *Cupressus Lawsoniana*, and a transverse section of *Picea excelsa*.

Mr. F. G. Walsingham, Assistant Director of Horticulture, Cairo.—Fruit of Doum Palm (*Hyphaene thebaica*), Egypt.

Mr. W. G. Wallace, Boscombe, Hants.—Two samples of Curare poison from the Amazon Valley.

Mr. C. U. Stuart, Seattle, U.S. America.—Fruits of *Viburnum pauciflorum* from Alaska.

Mr. A. Waterer, Knap Hill Nursery, Woking.—Fruits of *Corylus Colurna*.

The Hon. Vicary Gibbs, Elstree, Herts.—Paper manufactured from *Populus deltoides*.

Mr. F. D. Harford, C.V.O., Henbury, Bristol.—Photograph of a tree of *Ginkgo biloba* growing in the grounds of Blaise Castle. Height 70 ft., girth at 4ft. 6 ins. from the ground 10 ft. 3 ins.

Mr. H. C. Baker, Almondsbury, Gloucester.—Fruits of *Akebia quinata* and of *A. lobata*.

Messrs. F. W. & E. Bloore, Timber Merchants, Ferndale Road, Clapham.—A finely figured slab of Mahogany.

Messrs. Wigglesworth & Co., Fenchurch Street London.—Sample of Flax (*Linum usitatissimum*), from British East Africa.

Mr. H. Kempshall, Abbotsbury Gardens, Dorchester.—Section of stem of *Acacia dealbata*.

Mr. C. Warren, Curator, Agricultural Department, Nigeria.—Abnormal fruit of *Cocos nucifera* and a cake of Camwood prepared from *Baphia nitida*, at Banoara, Southern Nigeria. J. M. H.

Research in Jodrell Laboratory in 1917.—Mr. J. Bintner continued his observations on the development of callus-tissue and the formation of roots in cuttings, and began a study of some galls on the stem of one of the *Proteaceae*.

Mr. L. A. Boodle studied some of the properties of charred wood, and was engaged in anatomical work of various kinds.

Mr. A. Sharples began an investigation of *Hevea*-wood attacked by *Ustulina zonata*.

Mr. W. C. Worsdell examined the comparative anatomy of *Compositae*, *Polygonaceae*, etc.

Pathological Laboratory.—A special feature of the season 1917 was the marked increase of interest in fungus and insect diseases of plants, and the recognition by a large body of the public of the amount of damage which various plants pests are capable of inflicting.

In some of the southern and south-west districts bad attacks by caterpillars on fruit trees in the spring, severe scabbing of the fruit later, and extensive outbreaks of potato blight caused very considerable losses, and large growers and market gardeners as well as amateurs appealed for advice and for better methods of control, both by letter and by visits to the laboratory.

With regard to the staff, Mr. W. B. Brierley was absent on military duty from 6th January to the end of March. Mrs. N. L. Alcock was appointed permanent assistant, and has been engaged particularly on diseases of fruit trees. Miss M. N. Owen was appointed temporary technical assistant in January.

I.—Advisory Work.

Some 800 enquiries were received through the post, which represents an increase of nearly 300 over 1916. 99 different kinds of disease were represented, including 14 diseases of potatoes, 12 of apples, and 10 of cereals. Since the middle of August numerous questions relating to diseases received by the Food Production Department have been sent to Kew for reply.

In the spring many samples of seed potatoes were received and questions as to the desirability of planting those affected by dry rot, blight, and scab were replied to. Some 20 samples were affected by *Spicaria solani* which caused spots and markings similar to blight and has been often confused with it. The fungus causes very little damage, and it was recommended to plant the affected tubers even though they had in some cases been previously condemned.

The usual common diseases appeared as the season advanced, though American Gooseberry Mildew was conspicuous by its absence, and Whiteheads in Wheat was apparently less destructive than last year. A large amount of browned and scorched potato foliage was received for report, but it was not always possible to diagnose this satisfactorily owing to lack of opportunity for field investigation. Amongst the most prevalent diseases in 1917 were:—Black Currant Rust, Bean Pod Canker, Black Leg of Potato, Potato Scab on newly-broken ground, Plum Rust, Die Back of Apples, Onion Diseases (*Sclerotinia* and *Botrytis*) and Sooty Blotch of Apples.

Special mention should, however be made of the following:—

Black Currant Rust. (*Cronartium ribicola*).—Attention was called to this disease early in the year owing to legislative action by the United States of America. At the time the Black Currant Rust was supposed to be rare and local, and a memorandum was sent to the Board of Agriculture to this effect. The rust, however, was discovered in several districts about the middle of July, and by the end of the summer the disease was general throughout the whole of the southern counties, and extended as far north as Norfolk. In some cases it was extraordinarily abundant and caused severe defoliation. No outbreaks occurred at Ealing, Hounslow, or Kew, due perhaps to these districts being within the range of London smoke. The aecidiospore stage of the disease is very destructive to Weymouth Pine, and a report of the spread of the fungus in Britain in 1917 was submitted to the Board on October 27th. The outbreak serves to show how a disease may suddenly become epidemic after having existed in a country for many years in scattered localities. The appearance over so wide an area in 1917 suggests, however, that owing to the lack of an adequate phytopathological service the fungus had spread unnoticed during previous seasons.

Onion Disease.—In addition to suffering from *Botrytis* and Mildew, reports were received from several quarters that the onion crop was being badly attacked by a species of *Sclerotinia*. This disease, though long known, has never been properly

investigated, neither had the species been correctly determined. The fungus has been isolated, and it is proposed to work out its life-history, whilst Mr. Brierley will investigate the *Botrytis* with which it is often accompanied. The whole question of the diseases due to *Sclerotinia* and *Botrytis* is urgently in need of thorough investigation.

II.—Research.

American Gooseberry Mildew. (*Sphaerotheca mors-uvae*).—In continuance of the work on the dehiscence of the perithecia and the vitality of the spores of *Sphaerotheca mors-uvae*, on which a report was drawn up last year by Mr. Cotton and Mrs. Alcock, a number of bushes were planted in the Experimental Ground, and much material was collected The mildew, however, did not appear, and was completely absent in this neighbourhood in 1917.

Parsnip Canker.—This research was undertaken in response to enquiries from the Evesham growers last January, who stated that hundreds of tons of roots were being lost in their district. The work was carried out largely at Kew, and an account of the disease will be found in the current number of the *Bulletin* (see p. 8).

Wart Disease.—Owing mainly to the exigencies of the War and absence of inspectors this disease has spread very seriously in many parts of England, and through the distribution broadcast of contaminated seed it may be expected to appear even more widely in the near future. The absolute immunity of certain varieties is a piece of sheer good fortune which has saved the country from a very grave situation. The matter should not, however, be left in this position, as immunity may suddenly break down. The life-history of the fungus requires further study, and the factors conferring immunity should be elucidated. It was hoped to carry out a joint research by Mr. Cotton and Mr. Brierley on the life-history of the parasite and on the conditions especially necessary for the germination of the spores and infection of the host. The results so far obtained have been conflicting and chiefly negative, and the work has had to be set aside. The problem is a large and important one, and a thorough investigation, along biochemical lines, is urgently needed, and should be made a whole-time study by a competent investigator. The small size of the Staff has hitherto prevented this from being undertaken at Kew, even were the locality suitable for the purpose.

A series of experiments, designed to show the amount of heat required to kill the resting spores was attempted in the yard attached to the laboratory, but owing to the controls becoming infected the results were vitiated. The yard arrears now to be thoroughly contaminated with wart disease spores.

Apple Mildew (*Podosphaera leucotricha*).—The research on this disease was concluded. It was found that perithecia-formation often took place in the older parts of the mycelium, but

in spite of this the ascospores are apparently of little importance in the life-history of the fungus, as it reproduces itself by means of hibernating mycelium. The disease, therefore, must be controlled by pruning, and not by spraying, though experiments conducted at Wisbech and elsewhere showed that the conidial stage of the fungus could be very materially checked by the use of a strong lime-sulphur wash. A paper on the subject will shortly be published.

Botrytis.—A comparative investigation of the morphology and parasitism of the fungus *Botrytis cinerea* has been carried out by Mr. Brierley, particularly in *Aesculus Pavia* and *Ribes alpinum*. An account of the behaviour of the fungus in the former will be found in *Kew Bull.*, 1917, p. 315. In *Ribes alpinum* the fungus was found to be confined to the dead, water-conducting elements of the stem, and is present throughout the aerial portion of the plant, developing along with the host and existing in a symbiotic condition with its tissues. The host is stunted and stimulated to the formation of galls which morphologically are adventitious roots.

The results of an investigation of the morphological characters of *Botrytis cinerea* and their specific value will be published in the *Bulletin* in the course of the year.

Progress has also been made during the year in the investigation of *Thielavia basicola* and *Trichophyton crateriforme*.

The Experimental Ground.—A portion of the new ground acquired last year in place of the old plot has been laid out in beds and enclosed with fruit and other trees. Of the remaining portion a large part was used for the cultivation of potatoes and other vegetables. The laid-out portion is now stocked with a few specimens of the commonly grown market varieties of fruit, including special plots of gooseberries and black currants for experiments with American Gooseberry Mildew and *Cronartium ribicola* respectively. Observations were made during the past season on several potato and tomato diseases. Five plots were devoted to parsnip for work on Canker, and though fairly satisfactory results were obtained the sticky nature of the soil rendered it not particularly suitable for experimental work of this nature.

III.—Travelling.

Official visits were paid to the Wisbech district in connection with the spraying of apples for Apple Mildew and other diseases, and to Evesham and Worcester with reference to parsnip canker, Silver Leaf in plums, and obscure diseases of the potato. The spread of Weymouth Pine Rust was examined at Oxford, and visits were paid to Ormskirk and other localities in connection with Wart Disease and other maladies of the potato. A.D.C.

Presentations to the Library during 1917.—Prof. C. S. Sargent, Director of the Arnold Arboretum, has continued to send to Kew the official publications of the Arboretum, and these

of 1917 include *The Conifers and Taxads of Japan*, by E. H. Wilson, and the final part of *The Plantae Wilsonianae*. The last-named work is in nine parts, forming three thick octavo volumes, comprising altogether nearly 2000 pages. Among Prof. Sargent's other presentations is a copy of *Color Standards and Color Nomenclature*, by R. Ridgway.

Prof. Hans Schinz has sent No. 76 of the *Mitteilungen aus dem botanischen Museum der Universität Zürich*. From the Conservator of Forests, Western Australia, have been received *A Discussion of Australian Forestry*, by D. E. Hutchins, and a third edition of *Western Australian Timber Tests*, 1906 (and supplement), by G. A. Julius; and from the Trustees of the British Museum, parts 1 and 2 of the *Botany of the British Antarctic Expedition*, 1910. These deal with the Algae.

Prof. L. H. Bailey's *Standard Cyclopedia of Horticulture* has been completed by the issue in June of the sixth volume, and the establishment is indebted to the author and the publishers, Messrs. Macmillan, for an entire set of this extremely useful work.

Dr. E. R. Prósper, of the Central University, Madrid, has published, in a handsome quarto volume, a work of much interest, entitled: *Dos noticias históricas del inmortal botánico . . . Don Antonio José Cavanilles por D. Antonio Cavanilles y Centi y D. Mariano La Gasca*, a copy of which he has presented to the library. In a letter to the Director, Dr. Prósper mentions that both A. J. Cavanilles and La Gasca belonged to the Linnean Society of London, and that when the latter, being persecuted in Spain on account of his political views, took refuge in London, he was kindly treated by celebrated English savants. He was a pupil of Cavanilles and eventually succeeded him in the chair of botany at Madrid, after spending about eleven years (1824-34) in England and Jersey. He died at Barcelona, June 23, 1839 (*Proc. Linn. Soc.*, vol. i. p. 71). Cavanilles, who was born at Valencia, Jan. 16, 1745, and died at Madrid, May 4, 1804, was one of the original foreign members of Linnean Society (*Memoir of Sir J. E. Smith*, vol. i. p 347). The volume includes portraits of Cavanilles and La Gasca and numerous biographical notices of contemporary botanists.

Notwithstanding the extremely unsettled state of Russia there is evidence that some progress in botanical research has been made, and numerous publications have been received from Mr. Boris Fedtschenko, Mr. D. Janischewsky, Mr. H. A. Naumoff, and the Director of the Botanic Garden of Nikita, Yalta, Crimea. Mr. Fedtschenko's presentations include an illustrated Flora of Turkestan and the Kirghiz Steppes, and portions of a Flora of Asiatic Russia, both works being in Russian.

The second edition of the *Prodromus Florae Batavae*, published by the Netherland Botanical Society, vol. i. part 4 (Monocotyledons), has been received from the Secretary of the Society, and the four parts issued of the *Communications from the Netherland Government Institute for Advising the Rubber Trade . . established at Delft*, have been received from the

Council of the International Association for rubber cultivation in the Netherland Indies.

Prof. E. D. Merrill, of the Section of Botany, Bureau of Science, Manila, has been engaged for several years on the study of Rumphius's *Herbarium Amboinense*, which had been begun by Dr. C. B. Robinson, whose lamented and tragic death occurred in Amboina on Dec. 5, 1913. Prof. Merrill has now published the result of his researches in a volume of 595 pages, entitled: *An interpretation of Rumphius's Herbarium Amboinense*, a copy of which he has presented to the library. In the course of his investigations, Prof. Merrill has discovered over a hundred names, a list of which appears in his work, which have been omitted from the *Index Kewensis*.

A large selection of the extremely useful publications of the United States Department of Agriculture has been received, as in former years, from the Secretary of Agriculture, Washington. Dr. N. L. Britton has sent the parts published during the year of the *North American Flora*, and the Director of the Department of Agriculture in the Dutch East Indies, the various publications issued under his direction. The Bentham Trustees have presented such of the periodicals and serials received in exchange for *Hooker's Icones Plantarum* that have been published and distributed.

The following have also been received: *Travaux du Laboratoire de Matière Médicale de l'École Supérieure de Pharmacie de Paris*, published under the direction of Prof. E. Perrot, vols. v.-x.; *A Contribution to the Phytogeography and Flora of the Arfak Mountains* (Dutch N.W. New Guinea), by L. S. Gibbs, and *The Australian Flora in Applied Art*, part 1, *The Waratah*, by R. T. Baker, from the Director, Royal Botanic Gardens, Kew; *A Record of Plants collected in Southern Rhodesia*, by F. Eyles, and other publications, from the Assistant Director; *Bibliographie des Travaux scientifiques...publiés par les Sociétés savantes de la France*, by J. Deniker, tome i. livraison 3, from the Director of the Natural History Museum, Paris; several memoirs on Palaeobotany, by E. W. Berry, from Mr. L. A. Boodle; *Farm Forestry*, by J. A. Ferguson, from the publishers, Messrs. Chapman and Hall; *Icones Plantarum Formosanarum*, by B. Hayata, vol. vi., from the Bureau of Productive Industries, Government of Formosa; *Gleanings in old garden literature*, by W. C. Hazlitt, from Miss M. Smith; *Vernacular list of Trees, Shrubs and Woody Climbers in the Madras Presidency*, by A. W. Lushington, from Mr. J. S. Gamble; *Specula physico mathematico-historica notabilium ac mirabilium sciendorum...*(Norimbergae, 1696), by J. Zahn, from Sir Frank Crisp, Bart.; and *Proceedings of the First Agricultural Conference, Malaya*, from the Director of Agriculture, Federated Malay States.

The more important of the publications added to the library as presentations from authors are:—*British Grasses and their employment in Agriculture*, by S. F. Armstrong, (from the author and the Syndics of the Cambridge University Press); *Trees and Shrubs hardy in the British Isles*, by W. J. Bean,

second edition; *Monographie du Genre Melampyrum, L.*, by G. Beauverd; *Marine Algae of the Danish West Indies*, by F. Börgesen, vol. iii. pp. 145-240; *La Fôret et les Bois du Gabon*, by Auguste Chevalier; *Descriptive list of Trees, Shrubs, and Economic Herbs of the Southern Circle, Central Provinces* (India), by H. H. Haines (from the author and the Secretary to the Commissioner of the Central Provinces); *Catalogue des Phanérogames de l'Argentine*, by L. Hauman and G. Vanderveken, and 3 pamphlets by L. Hauman; *The Trees, Shrubs, Herbs and Climbers of Sierra Leone*, by C. E. Lane-Poole (2 copies); *Los Poliporáceos de la Flora Española*, by B. Lázaro é Ibiza; *Bitter Pit investigation*, fifth report, by D. McAlpine (from the author and Director of Quarantine, Melbourne); *A critical revision of the Genus Eucalyptus*, by J. H. Maiden, parts 28 and 31; *A monograph of the Genus Brickellia*, by B. L. Robinson; *The Ohia Lehua Trees of Hawaii*, by J. F. Rock (2 copies); Hand book of the *Bryophyta of South Africa*, by T. R. Sim, parts 1 and 2; *Seeding and Planting*, by J. W. Toumey; and the *Sixteenth report of the Woburn Experimental Fruit Farm*, by the Duke of Bedford and Spencer U. Pickering.

To the collection of travels has been added E. S. Meany's work on Mount Rainier, which has been presented by Mr. Hervey Lindley, and amongst the periodical publications received are several parts of the *Annals of the South African Museum*, from the Trustees, and the *Bulletin de l'Institut-Oinoue*, Tokio, extra number, from Mr. Y. Oinoue.

Manuscripts received include a valuable collection of 49 letters from Dr. F. Welwitsch, the celebrated explorer of Angola, to the late Prof. Daniel Oliver, written, judging from those bearing dates, between Sept. 29, 1864, and Dec. 7, 1868, part of the period during which Welwitsch was resident in London. These letters have been presented by Prof. F. W. Oliver. A typed copy of *A List of Plants found in the District of Uitenhage... together with a description of some new species*, by C. F. Ecklon, published in the rare *South African Quarterly Journal*, vol. i. no. 4, pp. 358-380 (1830), has been received from Dr. Schönland. The cost of the preparation of this copy, which comprises 31 folio pages, was borne by Mr. F. H. Holland, of Port Elizabeth.

Additions to the Herbarium during 1917.—During the year about 6000 specimens were received as donations or exchanges, 1559 were purchased and 888 were received on loan. The principal collections are enumerated below:—

Europe.—*Purchased*: Dr. J. W. Ellis, Drawings of British Fungi; H. Sudre, Herbarium Hierasorum, fasc. 7.

North Africa.—*Presented*: Egypt (F. G. Walsingham) by the Ministry of Agriculture, Cairo; Sollum, by Capt. K. B. Williamson.

China.—*Presented*: China (G. Forrest and F. K. Ward), by the Royal Botanic Garden, Edinburgh; China and Japan (E. H. Wilson), by Prof. C. S. Sargent.

India.—*Presented:* Madras, by the Madras Government Herbarium through Mr. J. S. Gamble; Malay Peninsula, by Mr. I. H. Burkill, and the Federated Malay States Government through Mr. C. Boden Kloss.

Malaya.—*Presented:* Siam, by Phra Vanpruk, Khun Winit Wanadorn, and the Federated Malay States Government through Mr. C. Boden Kloss.

Australia.—*Presented:* Eucalypti and Acacias, by the Director of the Botanic Gardens, Sydney; Mosses by Mr. W. Greenwood; Bellenden Ker Range, by Miss L. S. Gibbs.

Tropical Africa.—*Presented:* Uganda, by Mr. J. D. Snowden; Katanga, by Mr. A. Ringoet; Southern Rhodesia (J. A. S. Walters), by the Department of Agriculture, Rhodesia, and Mr. F. Eyles; Rhodesia, (A. J. Teague) by the Bolus Herbarium.

Purchased: Rev. F. A. Rogers, Rhodesia and the Belgian Congo; R. A. Dummer, Uganda.

South Africa.—*Presented:* Mosses and lichens, by the South African Museum.

North America.—*Presented:* British Columbia, by Miss E. M. Warren; United States (H. Eggert and others), by the Missouri Botanical Garden.

Central America.—*Presented:* Mexico (Frères G. Arsène and Nicolas), by Prince R. Bonaparte.

South America.—*Presented:* Colombia, by Mr. M. T. Dawe; British Guiana, by Mr. A. Leechman; Peru (Sr. N. E. Esposto), by Prof. Jules Gaudron.

Plants have been received from Mr. W. B. Turrill, Assistant in the Herbarium, who has collected them while on active service. The Chinese plants collected by Messrs. Forrest and Ward contain interesting specimens of Rhododendrons. The specimens received from the Federated Malay States Government contained plants collected in the Langkawi and Telebin Islands by Mr. C. Boden Kloss. Mr. J. M. Black has presented specimens of new species of Australian plants described by him in the *Transactions of the Royal Society of South Australia.* Miss L. S. Gibbs has given specimens collected by her in the Bellenden Ker Range. Some of Mr. J. D. Snowden's plants came from Mt. Elgon. An interesting collection from Katanga containing many plants of economic interest has been received from Mr. A. Ringoet. Miss E. M. Warren has sent additional specimens from the Kootenay region of British Columbia. Mr. M. T. Dawe's Colombian collections have been made along the Rio Magdalena, Santa Marta, Cartagena and the Goajira Peninsula. Prof. W. Bateson has presented South American Calceolarias and hybrids produced from them. Two important sets of drawings have been received: one of British Fungi from the collection of the late Dr. J. W. Ellis (See *K.B.* 1917, 87); the other of Orchids drawn by Mrs. Janet Ross and presented by the Bentham Trustees (See *K.B.* 1917, 85).

Hippocratea Cumingii and H. Maingayi.—An enquiry as to the original specimen of *Hippocratea Cumingii* reveals an amount of confusion that can only be dealt with in a short note. *Hippocratea Cumingii*, Laws., was described in 1875, being based upon flowering specimens collected in Malacca by Griffith, and in the Philippines by Cuming (no. 1725), the specific name being derived from the latter. Sir George King afterwards enumerated it as an imperfectly known species. It proves on comparison to be identical with the earlier *H. macrantha*, Korth., based upon a specimen collected at Banjermassing, Borneo. The latter name was unfortunately transferred by Sir George King to another plant, with the remark, "flowers of Chittagong and Assam specimens of this which I have dissected agree perfectly with Korthals' figure." This figure, however, shows villous petals, and the other characters are also not in agreement. He also cites as synonymous. *H. lanceolata*, Ham., *H. grandiflora*, Wall., and *H. obtusifolia*, Laws. (in part, not of Roxburgh), with the additional localities, Sikkim, Burma, South Andaman and Perak. These, unfortunately, do not represent the plant of Korthals, and, further, the Perak plant is distinct from the others cited, and has been described under the name of *H. nigricaulis*, Ridl. It also includes a specimen from Malacca, Griffith, which is written up as *H. obtusifolia*, Roxb., though not cited by Lawson, so that it is uncertain whether he intended to include it. There is also the difficulty that both Wallich and Lawson included under *H. obtusifolia*, Roxb., materials which do not belong to it, as pointed out by Sir George King. This point, however, has not yet been fully cleared up. The Perak specimen just mentioned, however, belongs to *H. nigricaulis*, Ridl. The synonomy and distribution are as follows:—

H. macrantha, *Korth.* in Temminck, Verh. Nat. Gesch. (1839-42), p. 187, t. 39 (non King). *H. Cumingii*, Laws. in Hook. f. Fl. Brit. Ind. i. p. 624 (1875).—Ceylon, *Walker*; Malay Peninsula: Malacca, *Griffith*; Kew Distrib. 906; Johore, *Ridley* 4183, 11139, 13446; Borneo: Banjermassing, *Korthals*; Kuching, *Haviland* 2859; Kulong, *Haviland* 2876; Sarawak, *Beccari* 4063; Philippines: Island of Samar, *Cuming* 1725.

H. nigricaulis, *Ridl.* ined., *H. macrantha*, King, Mat. Fl. Malay Penins. i. (1896) p. 643, in part, (excl. syn.; non Korth.). —Malay Peninsula: Malacca, *Griffith*; Perak, *King's Collector* 5118, 7570, *Wray* 631; *Scortechini* 1047.

The two plants are readily distinguished. *H. macrantha* has distinctly acuminate leaves, and petals densely glandular-villous on the inner surface, while *H. nigricaulis* has obtuse, or very shortly and abruptly acuminate leaves, and the petals are glabrous.

Hippocratea Maingayi, Laws., was based on a fruiting specimen collected at Malacca by Maingay, with the distribution "? Borneo", the source of which is Sarawak, Beccari, no. 3005. Both, however belong to *Lophopetalum reflexum*, Laws., which

is based on a flowering specimen from Malacca, Maingay. The synonymy and distribution are as follows:—

Lophopetalum reflexum, *Laws.*, in Fl. Brit. Ind. i. p. 616 (1875), King, Mat. Fl. Malay Penins. i. p. 638. *Hippocratea Maingayi*, Laws. in Hook. f. Fl. Brit. Ind. i. p. 625 (1875).—Malay Peninsula, *Maingay*, Kew Distrib. 393/2, 397; Penang, *Curtis* 1502, 3607; Borneo: Sarawak, *Beccari* 3005. R. A. R.

Strychnos angustiflora.—The button-like seeds of this Hongkong *Strychnos* are so similar in their general appearance to those of *S. Nux-vomica* that it seemed desirable to have them analysed. Mr. Tutcher, Superintendent, Botanical and Forestry Department, Hongkong, to whom we are indebted for a supply of seeds, also informed us that he had recently received an application from a Chinaman to cut down all *S. angustiflora* plants growing near his house as the fruits dropped into a stream from which he obtained his water supply and poisoned the water.

Prof. Greenish, who has kindly examined the seeds at the laboratories of the Pharmaceutical Society informs us that working by the Pharmacopœia method the residue which would contain all the strychnine and brucine amounted to only 0·028 per cent. and gave only a slight reaction for alkaloid. No trace of strychnine or brucine is present in seeds.

The poisonous property alleged to be present in the plants growing in Hongkong may therefore reside in the fruit or the assertion may prove to be unfounded.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

Nos. 2 & 3.] [1918

VII.—THE GENUS CHROZOPHORA.

D. Prain.

The Euphorbiaceous genus *Chrozophora* is so easily distinguishable from its nearest allies as to suggest that it is a 'natural' one. The divergence of view that has prevailed as to the limitation of its component forms has been so striking as to indicate that it is a 'difficult' one. These forms, Bentham remarked in 1880 (*Gen. Plant.* iii. p. 305) are 'inter se valde confusae nonnullae revidendae et forte iterum dividendae vel reducendae.' In a serious attempt to supply the revision thus advocated, which was published by Pax and K. Hoffmann in October, 1912 (*Pflanzenr.* IV. 147 vi. pp. 17-27), the species recognised have been said to be 'inter se saepe simillimae et caute examinandae.'

This was the experience met with when an account of the African species, also, as it happens, published in October, 1912 (*Fl. Trop. Afr.* vi. 1, pp. 834-9), was being prepared. While that study was in progress, it was found impossible to arrive at definite conclusions regarding some of the African forms until careful investigation had been made of the material available from Europe and Asia. This involved, in fact, the examination of all the specimens in a number of different herbaria, including those of Kew, the British Museum, the Linnean Society of London, Paris (including the Lamarck and Jussieu collections and that of M. Drake del Castillo), Brussels, Leiden, Copenhagen, Geneva, Berlin (including the Willdenow herbarium), and as regards Indian material that of Calcutta and that of Mr. J. R. Drummond. In this way it has been possible to see the actual specimens on which the opinions of Tournefort, Linnaeus, Lamarck, Forskål, Vahl, Willdenow, Roxburgh, Ad. Jussieu, Bunge, Wallich, Baillon, Anderson, Dalzell, Schweinfurth, Müller, Boissier, Hooker, Broun, and Cooke have been based. The only types not seen have been two each of Burmann and Visiani, and one each of Geiseler, Delile, and Presl; the present whereabouts of these seven types it has not been possible to trace.

The recent monograph in the 'Pflanzenreich' renders unnecessary the preparation of another. At the same time a survey of the material known to be available for study may be of use as

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a supplement to the 'Pflanzenreich' monograph, and may serve as a guide to the whereabouts of the material which it will be incumbent upon the future monographer of the genus to consult.

History of the Genus.

The name *Chrozophora* was applied by Necker in 1790 (*Elem.* ii. p. 337) to a monotypic genus based on a plant from Languedoc which at that date was the source of one of the Litmus dyes known as Tournesol. This name has, indeed, been used by most botanists since the XVIth century for the plant itself. That plant had been referred by Royen in 1740 (*Fl. Lugd.* p. 532) to the genus *Croton* as defined by Linnaeus in 1737. In 1748 Linnaeus accepted this determination (*Hort. Upsal.* p. 290); it was adopted by his friend and correspondent Sauvages in 1750 (*Monspel.* p. 305) before Linnaeus enumerated it, with a definite specific epithet, as *Croton tinctorium* in 1753 (*Sp. Pl.* p. 1004).

Royen was not the first writer to refer the Tournesol to a genus from which it is better kept apart. The plant was well known to systematic writers in the XVIth century. Some of these, convinced that words connoting the same idea should denote the same thing, connected the Tournesol now with one, now with another of the plants which the ancients termed *Heliotropion*. Of these the Greeks, according to Dioscorides, knew two sorts—*ἡλιοτρόπιον τὸ μέγα*, or *Σκορπίουρον*; and *ἡλιοτρόπιον τὸ μικρὸν*. The Latins, according to Pliny, also knew two—*Heloscopium*, or *Verrucaria;* and *Tricoccon*, or *Scorpiurum*.

In 1554 Castell-Branco, better known as Amatus Lusitanus (*Diosc. Enarrat.* p. 437), identified the Tournesol of Spain with *ἡλιοτρόπιον τὸ μέγα*, and repeated this identification with some insistence, by including also the Tournesol of France, in the larger edition of this work (p. 741) in 1558. This emphasis may have been due to the fact that in 1554 both Dodoens (*Cruydeboek* p. lxii.) and Mattioli (*Comm. Diosc.* p. 561), had suggested a different identification. It may have been intensified because Clusius in 1557, in his French version of Dodoens (*Hist. Pl.* p. ult.), had figured the Tournesol as *Heliotropium parvum*, and therefore as *ἡλιοτρόπιον τὸ μικρόν*. In this suggestion Clusius differed from Dodoens and Mattioli as regards *τὸ μικρόν*, just as Amatus did from both as regards *τὸ μέγα*.

In 1561 Pinaeus (*Hist. Pl.* p. 637), while repeating the figures of Mattioli, suggested that the *Heliotropium minus* of the latter may be the *Heliotropion* which Pliny termed *Tricoccon*. In the same year Aloysius Anguillaria (*Sempl.* p. 302), while accepting as 'Heliotropio maggiore' the plant figured by Mattioli, rejected the conclusion of the latter as regards 'Heliotropio minore' and applied the latter name to a plant then growing in the botanic garden at Padua. An agnostic attitude towards both plants was adopted by Cordus in another work (*Annot.* p. 76 verso), also published in 1561. Here Cordus has remarked of *τὸ μέγα*: 'qualis sit herba et quomodo jam vocatur, ignoro cum omnibus'; of *τὸ μικρόν*: 'quae sit hodie omnino ignoramus.' This did not deter Gesner from identifying, in a treatise appended to that

of Cordus (*Hort. Germ.* p. 261 recto), the two plants of Dioscorides with two species in his own garden, which differ from every plant referred to by any of his contemporaries or predecessors. The identity of these plants is not here a matter of moment, since neither of them is the Tournesol. What, however, does concern us is that Gesner was satisfied that one of Pliny's plants, 'Heliotropium minus quod et Tricoccum cognominant' must be distinct from either of those described by Dioscorides. With 'Tricoccon' Gesner identified the plant in the Padua garden which, we learn from him, had been raised from seed sent from Crete. This plant, which Gesner, from hearsay, believed to be wild near Montpellier, he considered unworthy of cultivation. Nevertheless, as we learn from Schmiedel (*Gesn. Op. Bot.* i. t. 4, fig. 30), Gesner made a drawing of the Padua garden plant, which shows that this plant was a form differing only in the outline of its leaves from the Tournesol of Spain and Provençe, figured by Clusius.

In 1570 Pena, collaborating with L'Obel, adopted Gesner's view, and, abandoning the terms *parvum* of Clusius and *minus* of other authorities, renamed the Languedoc plant 'Heliotropium vulgare Tournesol gallorum sive Plinii Tricoccon' (*Advers.* p. 101). In 1576 Clusius (*Rar. Hisp.* p. 395) also accepted the identification of Gesner in preference to his own of 1557, and figured as *H. minus tricoccum* the plant known 'castellanis Tornesol narbonensibus Tornesola quae voces,' he added, 'a graeco nomine deductae videntur.' In the same year L'Obel, writing alone, reverted to the view of Pinaeus, and published the same figure (*Hist. Stirp.* p. 133) as 'Heliotropium parvum, Diosc.; H. minus Clusii; Triccon [*sic*] Plin.; Advers. p. 101.' The erroneous typography was corrected in 1581 to 'Tricoccon' (*Ic. Stirp.* p. 261).

When, in 1586, Camerarius issued a revision of Mattioli's Compendium of 1571 he replaced Mattioli's figure of *H. minus* by Gesner's portrait of the Cretan plant in the Padua garden (*Epit. Matt. Diosc.* p. 1001), under the impression that it represented the tinctorial one of Narbonne. Two years later Camerarius had ascertained that the Languedoc plant also occurred in Italy—near Tresolza and elsewhere in Emilia, at Ortona and elsewhere in the Abruzzo (*Hort. Med.* p. 73). In the 1611 edition of his 'Kreutterbuch,' which is a German version of Mattioli's 'Commentaries,' Camerarius (p. 436*d*), again used Gesner's figure for the Tournesol which, he remarked in his own addition to the text (p. 437*a*), grows in Syria as well as in Italy and France. The figure employed, which is that of the plant raised at Padua from Cretan seed, represents with accuracy a form of the Tournesol which, as Camerarius has stated, 'is plentiful about Aleppo.'

The Lyons Herbal of 1587 (*Hist. Gen. Pl.* ii. p. 1352) compiled by Dalechamps, for the first time shortened the name of the Tournesol to *H. tricoccum*, and if Bauhin in 1596 (*Phytopin.* p. 48) reverted to the Clusian *H. minus tricoccum*, this author, in his 1598 edition of Mattioli, adopted Dalechamps' name (p. 893) when he intercalated the Clusian figure of the Tournesol

immediately after Mattioli's figure of *H. minus*. In 1623 Bauhin again used the name *H. tricoccum* for the Tournesol (*Pin.* p. 253) and this term, which remained current for over a century, was cited by Linnaeus in 1753 as a recognised synonym of his *Croton tinctorium*.

Necker was not the first botanist to regard the Tournesol as the type of a distinct genus. A quarter of a century earlier Adanson had done this, as O. Kuntze has remarked (*Rev. Gen. Pl.* ii. p. 621), under the old French name *Tournesol* used by Magnol and latinised by Scopoli into *Tournesolia*, 'welcher name' Kuntze has added, 'auch von Necker citirt und nur wilkürlich in *Chrozophora* verändert wurde.' This, although a perfectly accurate statement, does not tell the whole story; Magnol's use of the name *Tournesol* was not published until after his death.

The first author to accord generic rank to the Tournesol was Ray, who in 1686 dealt with the *Heliotropium tricoccum* of Bauhin (*Hist. Pl.* i. p. 165) under a natural group of plants far removed from that to which the remaining species of *Heliotropium* of earlier authors were relegated. Magnol, to whom Kuntze has referred, had not then formed this natural conception of the position of the plant, familiarly known to himself—'passim circa Monspelium aestate et autumno in satis reperitur et a rusticis colligitur ad pannos eleganti purpura colorandos, vulgo *tournesol*.' In the work published in 1686 (*Bot. Monspel.* p. 126) from which this passage has been taken, Magnol placed the plant next to the greater Heliotrope as *Heliotropium tricoccum*, Pin[ax]. Tournefort, however, in 1694, endorsed the action of Ray when, after having defined the genus *Heliotropium*, he remarked (*Elem.* i. p. 116) 'la plante qu'on apelle *Heliotropium tricoccum* n'est pas de ce charactère et doit faire un genre différent.'

This statement, more categorical than anything said by Ray, hardly advanced matters. If Ray did not give the new genus a distinctive name, at least he gave it a separate place. Tournefort, having followed Ray in throwing it out of *Heliotropium*, forgot to enumerate it elsewhere in his work. Magnol in 1697 (*Hort. Reg. Monspel.* p. 173) endeavoured to repair Tournefort's oversight by placing *Heliotropum tricoccon* B[auhin] Pin[ax]), which 'inservit ad pannos eleganti purpurâ tingendos,' at the end of *Ricinus* as 'Ricinis aliquo modo similis.' This new suggestion was in turn taken up by Tournefort when, in 1700 (*Inst. rei herb.* ed. alt. p. 651), he established the artificial genus *Ricinoides*, in which this tinctorial species was included as 'Ricinoides ex qua paratur Tournesol gallorum.'

This unsatisfactory arrangement again attracted the attention of Magnol to the Tournesol plant, for we find in the posthumous work (*Nov. Char. Plant.* p. 274), published by the younger Magnol in 1720, a genus *Tournesol* (lib. iii. pars iv. sect. ii. cap. ix.) based on 'Tournesol gallorum. Heliotropium Tricoccon B. Pin.' with the note:—'nec potest dici *Ricino* affinis'—thus cancelling his own view of 1697, 'nec *Ricinoides*'—thus

traversing Tournefort's conclusion of 1700, ' nullam enim habet cum *Ricino* similitudinem.' Eight years earlier, a good figure had been published under Tournefort's phrase (*Act. Acad.* 1712, p. 339, t. 17) by Nissolle to whom, by inadvertence, the name *Tournesol* was attributed by Adanson in 1763 (*Fam.* ii. p. 356). In 1777 Scopoli (*Intr. Hist. Nat.* p. 243) modified Magnol's name into *Tournesolia*, citing Nissolle as his authority. This circumstance was known to Necker when, in 1790, he proposed the new name *Chrozophora*.

In the meantime, however, new species were being added to *Ricinoides*, Tournef. In 1717, Hermann (*Zeyl.* 202, t. 11) reported one from Ceylon; in 1728, Martyn (*Hist. Pl. Rar.* cent. 1, ii. 38, 46) described two more from America. These, with others, were included, along with the Tournesol, in the genus *Croton* based by Linnaeus on the ruins of Tournefort's *Ricinoides*, so that from the outset the Linnean complex was even more confusing than that which it replaced. Notwithstanding all this, Moench, in 1794 (*Meth. Pl.* p. 286) proposed the revival of Tournefort's name *Ricinoides*, as a substitute for the name *Tournesolia* of Scopoli.

This attempt failed as those of Scopoli and Necker and Adanson had. The utility and convenience of his ' Species Plantarum ' were so great and so undeniable as to make the authority of Linnaeus paramount, and the particular arrangement adopted in the case of *Croton* was followed, in spite of its imperfection, to mention only those authors who have added to our knowledge of *Chrozophora*, by Burmann (*Fl. Ind.*) in 1768, by Forskål and his editor Zoega (*Fl. Aegypt.-arab.*) in 1775, by Lamarck (*Encyc. Meth.*) in 1786, by Vahl (*Symb. Bot.*) in 1790, by Willdenow (*Sp. Pl.*) in 1805, by Geiseler (*Crot. Monogr.*) in 1807, by Delile (*Fl. Aegypt.*) in 1812, by Sibthorp and Smith (*Fl. Graec.*) in 1813, by Roxburgh (*Hort. Beng.*) in 1814, and by La Gasca (*Gen. et Sp. Nov.*) in 1816. So far as India is concerned, the Linnean usage lasted rather longer; it was followed by Ainslie (*Mat. Med.*) in 1826, by Wallich (*Cat. Lith.*) in 1830, by Roxburgh (*Fl. Ind.*) in 1832, by Graham (*Cat. Pl. Bomb.*) in 1834. This, however, was largely accidental. Graham's local list was based on Roxburgh's recently published work; Ainslie's account was adapted from Roxburgh's manuscript. But Roxburgh's ' Flora ' was issued posthumously; it was written long before 1832. Roxburgh died in 1815; he left in the hands of Carey the manuscript from which the work was printed, when he departed from India in 1813. Wallich's list, in form and purpose, is a conspectus of the names used by Roxburgh and his contemporaries and correspondents Buchanan (afterwards Hamilton), Heyne, Koenig, Rottler and Russell.

When the generic status of *Chrozophora*, Neck., was revindicated by Ad. Jussieu in 1824 (*Tent. Gen. Euph.*), the spelling was changed to *Crozophora*. Jussieu's action was accepted and endorsed by Sprengel (*Syst. Veg.* iii.) in 1826. Link, who recognised the genus in 1831 (*Handb.* ii. p. 438), assuming, though the plant bears no particular resemblance to a

tassel or plume, that the etymology must be χροσσός and φορός, wrote the name *Crossophora*. With this exception, the orthography of Jussieu and Sprengel was copied by Spach (*Hist. Veg.* ii.) and Decaisne (*Florul. Sin.*) in 1834, the younger Nees (*Gen. Pl. Germ.*) in 1835, Endlicher (*Gen. Pl.*) in 1840, Reichenbach (*Ic. Fl. Germ. et Helv.*) in 1841, Ledebour (*Fl. Ross.*) in 1849-51, Bunge (*Rel. Lehm.*) in 1851, Payer (*Organogén.*) in 1857, Baillon (*Étud. gén. Euphorb.*) in 1858, Dalzell (*Fl. Bomb.*) and Klotzsch (*Mossamb. Bot.*) in 1861, Schweinfurth (*Pl. Nilot.* and other treatises) in 1862 and subsequent years, Müller (*DC. Prodr.*) in 1866, and Boissier (*Fl. Orient.*) in 1879.

A partial exception to the adoption of Sprengel's treatment occurred in 1836, when Visiani (*Pl. quaed. Aegypt. ac Nub.*) figured two species of our genus, one as a *Chrozophora*, the other as a *Croton*. Schweinfurth has suggested (*Pl. Nilot.* p. 12) that this segregation may have been due to imperfect characterisation of *Croton* by Necker and Endlicher. But Endlicher did not describe *Croton* till 1840, and there is nothing to suggest that Visiani went behind Ad. Jussieu. We know, however, that the stamens in the species which Visiani referred to *Croton* are 3-verticillate, in that referred by him to *Chrozophora* the anthers are 2-verticillate, so that Visiani may have been influenced by this character as much as by the calycine one to which he and Schweinfurth have alluded.

It appears possible that this difference as regards the androecium may explain another proposal to divide *Chrozophora* into two genera. In 1849 Presl (*Epimel. Bot.* p. 213) based a genus *Lepidocroton* on a plant from Kordofan. Presl has explained that he had before him two specimens, both collected by Kotschy on Mount Arash-kul and both issued by Hochstetter as 'Kotschy n. 113, *Croton serratus*.' One of them being a *Caperonia*, Presl named it *Caperonia serrata*. The type specimen, lent for inspection to Kew by Dr. Gunther Beck, has been so written up by Presl himself; it is a *Caperonia*. Presl's further note reads:— "Sub eodem numero et ex eodem loco alia adest planta quae Chrozophorae et praecipue C. senegalensi Spreng. Syst. iii. 850 (Croton senegalense Lam. enc. ii. 212) accedit sed aliud genus efficit, quod *Lepidocroton serratus* nuncupatur.' Dr. Gunther Beck and Dr. Pascher have made careful search for this second plant, but can find no trace in the Prague Collection of any specimen written up by Presl as *Lepidocroton serratus* or of any example of Kotschy n. 113 other than the one named *Caperonia serrata*. In 1858 Baillon (*Étud. gén. Euphorb.*) reduced *Lepidocroton*, Presl, to *Caperonia*, St. Hil. It is true that there are in the Paris collections more examples than one of Kotschy n. 113, and that all of these specimens represent *Caperonia serrata*, Presl. But, having regard to what Presl has written, this does not justify the reduction suggested by Baillon. From the definition of *Lepidocroton* provided by Presl we learn that as regards flowers and fruit the supposed genus agrees with *Chrozophora*, while as regards male flowers the only character separating *L. serratus* from *C. tinctoria* is the presence of fifteen stamens in place of ten. This character, we know now, is not of

generic value; there are five distinguishable forms in the genus *Chrozophora* which share it. The reduction of *Lepidocroton* to *Chrozophora* effected by Bentham in 1880 (*Gen. Pl.* iii. p. 305) seems, therefore, to be justified; it is at least free from the objection which attends that proposed by Baillon in 1858 and accepted by Müller in 1866 (*DC. Prodr.* xv. 2, p. 751). When accepting Bentham's reduction in 1912, Pax and Hoffmann (*Pflanzenr.* IV. 147, vi. p. 17) regarded as the type of *Lepidocroton* another Kordofan plant, collected by Kotschy at Abu Gerad and issued by Hochstetter as Kotschy n. 25, *C. senegalensis*, under which species the authors of the Pflanzenreich monograph account both for this specimen and for Presl's genus. This conclusion is open to the objection that Kotschy n. 25 has only seven to nine anthers whereas *Lepidocroton* should have fifteen. We know, however, that Kotschy did collect at Wolet Medine in Sennar another *Chrozophora* which was issued by Hochstetter as Kotschy n. 473, in which the male flowers have fifteen stamens. The species in question, *C. plicata*, A. Juss., is the only African *Chrozophora* which exhibits the character relied on by Presl in distinguishing his genus *Lepidocroton* from *Caperonia* on the one hand and from *Chrozophora* on the other. For this reason it is to *C. plicata* that, in an account of the African species of *Chrozophora* published in 1912 (*Fl. Trop. Afr.* vi. 2, p. 835), *Lepidocroton serratus* has been referred.

Reviewing his earlier studies, Baillon in 1874 (*Hist. Pl.* v. p. 181) decided that the relationship of *Chrozophora* to *Argithamnia*, Sw.; *Caperonia*, St. Hil.; and *Speranskia*, a genus proposed by himself, is sufficiently close to justify their treatment as component sections of a single genus, for which he resuscitated the name *Tournesolia*, employed by Scopoli in 1777. This comprehensive view was endorsed by Franchet in 1887 (*Journ. de Bot.* i. p. 135), and again advocated by Post and O. Kuntze in 1903 (*Lexic.* p. 43), though these last-mentioned writers, on bibliographical grounds, have preferred the name *Argythamnia*, P.Br. (1756) to that of *Tournesolia*, Scop. (1777). But neither Bentham in 1880 (*Gen. Pl.* iii. p. 305), nor Pax in 1890 (*Pflanzenfam.* iii. 5, p. 43) were able to accept Baillon's rearrangement. Even O. Kuntze in 1891 (*Rev. Gen.* ii. p. 621) only accepted it to the extent of replacing the name *Chrozophora*, Neck. (1790) by that of *Tournesolia*, Scop. (1777), a proposal for which there is much to be said.

When in 1880 Bentham reverted to the orthography originally employed by Necker he concluded that the etymology of the word *Chrozophora* is from χρώζω or χρώς, and although Pax and Hoffmann in 1912 have expressed their preference for the suggestion made by Link in 1831, the probability is that Bentham's derivation is correct, and that Necker desired by the word he proposed to convey in the generic name the idea that Linnaeus had embodied in the specific epithet adopted by him for the same plant in 1753. Though the name *Chrozophora* is not the oldest for the genus it is thus particularly apt, and as it has been accepted by all but two botanists, since 1826, its validity and its orthography are not likely to be further impugned.

Position of the Genus.

The position of *Chrozophora* within the *Euphorbiaceae* has since 1866 been the subject of some discussion. In 1866 Müller (*DC. Prodr.* xv. 2, p. 711) regarded the genus as representative of a group which he termed the *Chrozophoreae* and believed to be a subtribe of the *Acalypheae*, equal in rank with another subtribe, the *Caperonieae*, the type of which is the genus *Caperonia*, St. Hil., in which are included two of the species referred to *Croton* by Linnaeus in 1753. Baillon in 1874 (*Hist. Pl.* v. p. 181) reverted to some extent to the Linnean view; he regarded *Chrozophora* and *Caperonia*, not as the types of two subtribes in one natural family, but as the constituents of two sections in one Euphorbiaceous genus. Bentham in 1880 (*Gen. Pl.* iii. p. 248) and Pax in 1890 (*Pflanzenfam.* iii. 5, p. 42) were unable to accept so drastic a change of view. The former was, however, impelled to regard *Caperonia* as an integral part of the subtribe *Chrozophoreae*, which he placed within the *Crotoneae*. This deviation from the arrangement of Müller is not so great as might at first appear, because Bentham used the last-mentioned name in a sense more comprehensive than that of Müller. To Müller the *Crotoneae* constituted a group equal in status with the *Acalypheae;* to Bentham the *Crotoneae* appeared a group of higher status within which the *Chrozophoreae*, the *Crotoneae* proper (*Eucrotoneae*), and the *Acalypheae* enjoy equal rank. The most important difference between the view of Bentham and of Müller therefore lies in the fact that the former has treated the *Chrozophoreae* and the *Acalypheae* as of equal importance.

Pax has adopted a compromise between the two views. He has, like Bentham, merged the *Caperonieae* of Müller in his *Chrozophorinae*, but has at the same time, like Müller, subordinated the *Chrozophorinae* to the *Acalypheae*. It is hardly open to question that Pax has improved our conception of the position of the group by removing it from the *Crotoneae*, in which it was placed by Bentham. But this improvement has not been effected without a corresponding sacrifice, for there is equally little room for doubt that Bentham was right when he claimed for the *Chrozophoreae* a status equal to that of the *Acalypheae*. So far as mere convenience is concerned it is, however, clear that there is nothing to choose between the systems of Bentham and of Pax, and that either system is more satisfactory than that of Müller.

Characters of the Genus.

So far only two endeavours have been made to analyse the genus. To admit of an appreciation of these attempts a summary of the characters is necessary.

Chrozophora, *Neck. Flowers* monoecious, dichlamydeous. ♂ *Calyx* closed in bud, ovoid or globose, ultimately splitting into 5 valvate lobes. *Petals* 5, usually dirty yellow, rarely red, generally shorter than the calyx lobes, externally lepidote. *Stamens* 5-15; filaments connate, at least below, in a central column, the free portion usually shorter, rarely considerably longer than the anthers: anthers usually

2-seriate, 10 or fewer, less often 3-seriate, 15; cells parallel, contiguous; dehiscence longitudinal, extrorse. *Rudimentary ovary* 0. ♀ *Calyx-segments* valvate, narrower than in the male. *Petals* narrow, usually much smaller than in the male, sometimes setaceous, occasionally obsolete. *Disk* composed of 5 short wide rather prominent glands alternating with the petals. *Ovary* 3-celled, clothed either with stellate hairs or with flat peltate denticulate or subentire scales; styles 3, erect or somewhat spreading, usually stout, always 2-fid; style-arms entire, usually red, rarely orange; ovules solitary in each cell. *Capsule* 3-dymous, at first somewhat fleshy, usually tinctorial, when ripe red, violet purple, or white tinged with violet; occasionally non-tinctorial, when ripe grey or nearly black; pericarp smooth or tuberculate, clothed with stellate hairs or with flat pectinate or subentire scales, very rarely the scales obsolete. *Seeds* without a caruncle; testa smooth or somewhat rugose; albumen fleshy; cotyledons broad, flat.—Coarse *herbs*, usually monocarpic, less often *undershrubs* and polycarpic, everywhere clothed with stellate tomentum or very rarely nearly glabrous. *Leaves* alternate, stalked, usually undulately toothed, plicate-rugose or plicate-bullate or nearly flat, often with two glands near the apex of the petiole beneath. *Flowers* in short, dense, sessile or stalked racemes in the upper axils, each solitary to a bract; the males higher up, rather close-set, short-pedicelled or subsessile, the females near the base, few, distinctly or sometimes long pedicelled.

The first attempt to break up the genus into groups was made by Müller in 1866 (*DC. Prodr.* xv. 2, pp. 747-750). The primary sub-division was effected by separating the forms in which the anthers exceed 10 and are 3-seriately arranged from those in which the anthers are 10 or fewer and are 2-seriately arranged. All those forms in which the anthers are 3-seriate have stellate-pubescent but not lepidote capsules. Of those forms in which the anthers are 2-seriate, only one has stellate-pubescent but not lepidote capsules; this was accordingly separated by the character in question from the remaining forms, and thus provided Müller with a second group. The forms with 2-seriate stamens and lepidote capsules were subdivided by him into two more groups, according to the nature of the seed-coat, those with rough seeds constituting Müller's third group, those with smooth seeds his fourth and last group. The arrangement thus was:—

(1) Sect. 1. Stamina triverticillata, saepius 15. Ovarium pilis stellatis vestitum.

Sect. 2. Stamina 1-2-verticillata, 5-10:—

(2) Sub-sect. *α*. Ovarium pilis stellatis vestitum.

Sub-sect. *β*. Ovarium peltato-squamigerum:—

(3) Group 1. Semina tuberculato-asperata.

(4) Group 2. Semina laevia.

Müller did not suggest names for any of these groups.

The other attempt to arrange the components of the genus was made by Pax and Hoffmann in 1912 (*Pflanzenr.* IV. 147, vi. pp. 18, 19). Adopting the characters relied on by Müller, these authors have treated the group with 3-seriate anthers and stellate pubescent ovaries as a distinct section, 1. *Plicatae*. Those forms with 2-seriate anthers and lepidote capsules were subdivided into two more sections. Pax and Hoffmann have treated Müller's last group, in which the seeds are smooth, as a distinct section, 2. *Senegalenses*; the forms with 2-seriate anthers, lepidote capsules and tuberculate seeds they have regarded as forming a third section, 3. *Tinctoriae*. As compared with the arrangement proposed by Müller, that of Pax and Hoffmann supplies a section 1. *Plicatae*, corresponding with Müller s section 1, with two sections, 2. *Senegalenses* and 3. *Tinctoriae* corresponding, in reversed order, with Müller's two groups under Section 2, sub-section β. The defect in Pax and Hoffmann's system is that it does not deal quite consistently with the group which constitutes Müller's Section 2, Subsection *a*. In their careful Conspectus Sectionum (l.c. p. 19) these authors have been at pains to exclude the group in question both from their sections 2. *Senegalenses* and 3. *Tinctoriae*, though they have elsewhere (l.c. pp. 18 and 21) included it under 3. *Tinctoriae*, with the remaining members of which the second group of Müller does not accord, because its capsules are not lepidote and its seeds are not tuberculate. They adduce themselves yet another character for the group in question which separates it from their section 3. *Tinctoriae*, when they state that it has free filaments. This statement, besides being incompatible with their generic description (l.c. p. 17), rather exaggerates the condition met with, because the filaments, though the free portion be unusually long, are united and columnar below. The character to which Pax and Hoffmann direct attention is, however, sufficiently striking, when taken into consideration along with those supplied by the capsule and the seed, to suggest that Müller's second group cannot satisfactorily be included in the *Tinctoriae*, and to throw doubt on the conclusion (l.c. p. 18) that this group has been derived from their section 3. *Tinctoriae*.

Another interesting conclusion arrived at by Pax and Hoffmann is that their section 1. *Plicatae* is the most archaic group in the genus. But the evidence of reduction in the androecium, universal in their second section, 2. *Senegalenses*, and very general in their third section, 3. *Tinctoriae*, does not preclude the possibility that their section 1. *Plicatae* may be the consequence of a modification in the opposite direction.

Pax and Hoffmann (l.c. p. 18) have drawn certain phylogenetic conclusions with regard to *Chrozophora* from the variability met with in the androecium. Incidentally they have pointed out that in all the forms with lepidote capsules the anthers are in two whorls. Müller, in his review of the genus, has remarked that in these lepidote-capsuled species the anthers may at times be all in one whorl, and although Pax and Hoffmann have inadvertently transcribed this statement from Müller both in the generic description (l.c. p. 17) and in the conspectus (l.c. p. 18), they have in their diagnoses of the sections *Senegalenses* and

Tinctoriae (l.c. pp. 20, 21), based upon their own observations, repeated the fact that the anthers are 2-verticillate. There does not seem to be any exception to this; even in such extreme cases of reduction as result in the presence of only four anthers it is found that at least one of these belongs to a higher and more central whorl than the remaining three.

The scope of the present paper is such as to preclude the consideration of the interesting speculations themselves. The variability of the androecium on which they are based is, however, so great as to suggest that this portion of the flower is on that account less suitable as the source of a character on which to base a primary subdivision of the genus. It is clear, from the difficulty experienced by Pax and Hoffmann in dealing with the type of Müller's section 2, subsection *a*, that the new serial dispositions adopted by them is hardly an improvement upon that suggested by Müller in 1866, and it is satisfactory to find that, if we employ for the purpose of primary subdivision that to which Müller gave the second place, but which in the case of their section 3, *Tinctoriae*, Pax and Hoffmann have been compelled to disregard, we are able to maintain Müller's serial disposition and to break up the genus into what appear to be fairly natural groups.

Treating as a distinct section, 1. *Trichocarpa*, all those forms in which the carpels and ripe capsules are stellate-pubescent but not lepidote, and as another distinct section, 2. *Ledipocarpa*, all those in which the carpels and ripe capsules are lepidote but not stellate-pubescent, we are able further to subdivide *Trichocarpa* into two sub-sections; *α. Plicatae*, exactly as defined by Pax and Hoffmann, with 3-seriate anthers longer than the free portion of their respective filaments; and *β. Graciles*, the group treated by Müller as his section 2, sub-section *a*, with 2-seriate anthers much shorter than the free portion of their respective filaments. The section *Lepidocarpa* can then be similarly subdivided into *γ. Tinctoriae*, only differing by the exclusion of the *Graciles* from the section *Tinctoriae* as defined by Pax and Hoffmann, with purple, usually muricate, capsules loosely clothed with pectinate scales, and with always tuberculate seeds; and *δ. Senegalenses*, exactly as defined by Pax and Hoffmann, with yellowish or white smooth capsules imbricately clothed with subentire flat scales, and with smooth seeds.

In the subjoined conspectus, in which these various subdivisions are shown, the opportunity has been taken to enumerate the forms within each that have from time to time been recognised as distinct species. These 'species,' it should be understood, are recorded 'without prejudice'; the question of the validity of the claim in particular instances will be dealt with in the concluding section of this study. It should, however, be further understood that only those forms are here cited which have been distinguished by some competent authority, who has actually examined and compared representative specimens of closely allied plants. In cases where authors of equal authority have described a second time some form already adequately characterised, only the original name is given. An instance

of the first kind is supplied by *C. sabulosa* and *C. gracilis*, which were carefully distinguished by Ledebour (*Flor. Ross.* iii. p. 581), but which we now believe to be conspecific. An example of the second kind is supplied by *C. obliqua*, which has been described as a distinct species, under four different names, by Willdenow, Sibthorp and Smith, La Gasca, and Bunge, since it was first characterised by Vahl.

Conspectus of Sections and Forms hitherto Proposed.

Carpels stellate-pubescent but never lepidote ... ... §1. **Trichocarpa.**
Anthers 3-verticillate, longer than the free portion of the filaments ... ¶ *a*. Plicatae.
Capsules purple; stigmas red:—
Racemes nearly to quite as long as the adjacent leaves:—
Leaves ovate, hardly lobed ... 1. *Rottleri*, A. Juss.
Leaves rounded, more or less distinctly 3-lobed ... 2. *Burmanni*, Spr.
Racemes much shorter than the leaves:—
Leaves undulate; peduncles always very short, often leafy at the base... ... 3. *plicata*, A. Juss.
Leaves repand; peduncles distinct, always naked ... 4. *obliquifolia*, Baill.
Capsules grey or blackish; stigmas orange:—
Leaves 2-glandular at the base... 5. *parvifolia*, Klotzsch.
Leaves eglandular ... ... 6. *prostrata*, Dalz.
Anthers 2-verticillate, shorter than the free portion of the filaments; capsules purple; stigmas red ... ¶ β. Graciles.
Leaves all obtuse ... ... 7. *sabulosa*, Kar. & Kir.
Leaves acute, rarely obtuse ... 8. *gracilis*, Fisch. & Mey.
Carpels lepidote but never stellate-pubescent; anthers 2-verticillate ... §2. **Lepidocarpa.**
Capsules purple, their scales discrete, with pectinate margins; seeds tuberculate ... ... ¶ γ. Tinctoriae.
Capsules very distinctly muricate:—
Leaves twice as long as broad; ripe capsules blue-purple; stem erect ... ... 9. *oblongifolia*, A. Juss.
Leaves not much longer than broad; ripe carpels red-purple:—
Stem erect:—
Leaves thinly pubescent ... 10. *tinctoria*, A. Juss.
Leaves densely velvety ... 11. *hierosolymitana*, Spr.
Stem prostrate ... ... 12. *subplicata*, Pax & Hoffm.

Capsules slightly muricate or nearly smooth:—
Leaves densely softly villous with long hairs ... ... 13. *obliqua*, A. Juss.
Leaves almost glabrous ... ... 14. *glabrata*, Pax & Hoffm.
Capsules nearly white, their scales contiguous or imbricately overlapping, with subentire or entire margins; seeds smooth ... ¶ δ. Senegalenses.
Leaves heterophyllous, dark-green and glabrous or nearly so above, closely hoary or laxly woolly beneath ... ... 15. *senegalensis*, A. Juss.
Leaves uniform in outline, paler green, from puberulous to woolly above and from closely hoary to laxly woolly beneath.. 16. *Brocchiana*, Vis.

History of the Species under Ricinoides.

When in 1700 Pitton de Tournefort placed the Tournesol in his genus *Ricinoides*, he termed it 'Ricinoides ex qua paratur Tournesol gallorum' (*Inst. rei herb.* ed alt. app. p. 655), a phrase perhaps more accurate than that of the authors of the XVIth century, who transferred the name of the dye to the plant which yielded it. During his travels in the Orient in 1700-2 Tournefort became acquainted with a second species, the type of which was collected by Gundel in the island of Melos, one of the Cyclades. This second species Tournefort in 1703 published (*Cor.* p. 45) as *Ricinoides ex qua paratur* Tournesol *gallorum, folio oblongo et villoso*, taking the opportunity to amplify the name of the original species from Southern France to *Ricinoides ex. qua paratur* Tournesol *gallorum, folio serrato non villoso*. There is in the Jussieu herbarium an example of this plant collected in Melos by Gundel, which has been named by Tournefort himself. In the British (Natural History) Museum there is a specimen of each of these two species, both of them written up by Tournefort.

There is in the Jussieu herbarium a specimen originally in the herbarium of Danty d'Isnard, which has been written up by Isnard himself as *Ricinoides memphiticus folio laevi, Lippi.* As the leaves are pubescent it cannot be the species Lippi had in mind when he proposed that name, and a later note accompanying the specimen, written, it would, however, appear, before the specimen itself reached A. L. Jussieu, says:—'Cette plante comparée avec la description de Lippi ne lui convient pas.' The plant is an example of *Chrozophora oblongifolia*, A. Juss., a species which in Egypt is strictly confined to the Red Sea littoral. We know, therefore, that, even if there had been no insuperable objection on morphological grounds to the identification by Isnard, the specimen did not come from anywhere near Memphis. This, however, does not affect the possibility that it was obtained by Lippi; the fact that Isnard wrote it up as one of Lippi's plants renders it probable that it had been collected,

or at least formed part of the herbarium accumulated by that unfortunate traveller. Lippi accompanied Lenoir Duroule during the embassy of the latter to the Court of Abyssinia in 1704-5. After landing at Alexandria Lippi made various excursions in Lower Egypt before he set out on the Abyssinian journey, in the course of which he was murdered in 1704. It is known that he was able to visit Rosetta, Cairo, and Assiout, and although we are not told that he visited Suez, we are aware that if he did make that particular excursion, or if he sent a collector there, he could hardly have failed to find, in the neighbourhood of that town, the species attributed to him by Isnard.

Some twenty years later yet another species of the genus was collected in India by Garcin, then a surgeon in the service of the Netherlands East India Company. On 11th August, 1722, Garcin left Batavia in a vessel bound for Surat. Garcin landed there during the first week of January, 1723. In his journal Garcin wrote:—'La Saison ou je me rencontray dans Suratte n'estoit point celle des plantes parceque la Secherease qui y regnoit. . . avoit brulé toute la Verdure.' But further on he has added:—'J'amassay quatre à cinq sortes de Semences de plantes que me parurent inconnues, mais je ne pû en examiner le genre parcequ' elles estoient trop passées. Je reservay ces Semences dans le dessin de les semer dans quelque jardin à Batavia pour les examiner avec plus de Loisir.' In 1724 Garcin made a second voyage to Surat, and was able to stay longer there. Among the specimens he then collected was one which he termed *Ricinoides malabarica surattensis.* A specimen of this species was either given or lent to Burmann, who figured it as a *Croton* in 1768 (*Flor. Ind.* t. 63, fig. 1). In the same work (t. 62, fig. 1) Burmann figured, also as a *Croton*, another specimen of the same species, collected by Garcin in Java. Neither of these specimens is to be found now in the Burmann herbarium, and their whereabouts, if they still exist, cannot be traced. The species, which is that now known as *Chrozophora Rottleri*, A. Juss., will be dealt with more fully when Burmann's drawings of these two specimens are discussed.

History of the species under Croton.

When Linnaeus published *Croton tinctorium* in 1753 (*Sp. Pl.* p. 1004) he possessed only one specimen of this species. That specimen, which came from Montpellier, is still in his herbarium, where it was written up by himself. He did not know or cite the species collected by Gundel in Melos, or the species from the Red Sea littoral attributed by Isnard to Lippi, or the species from India collected by Garcin. In 1774, however, Koenig collected in Southern India and sent to Linnaeus a specimen of the plant which Garcin had found fifty years earlier at Surat. Koenig's note, still attached to the specimen, is as follows:—Croton agrestis caule erecto brevi obsolete angulato, rami patentissimi foliis cordatis sublobatis undulatis utrinque pilositate exasperatis; habitat agris argillosis. The younger Linnaeus wrote up the specimen, which is still in his father's herbarium, as 'Croton tinctorium.' One consequence of this

inability to distinguish a species with stellate-pubescent carpels from one with lepidote carpels has been that Koenig's suitable name and excellent diagnosis were not published.

It is possible that the younger Linnaeus was guided by the judgment of Burmann, who, in 1768, when publishing figures of two specimens of this particular species, both of them collected by Garcin, named one of them *Croton tinctorium* (*Fl. Ind.* t. 62, fig. 1). It may be that Burmann was to some extent influenced in his decision to refer the second specimen of the same plant to *Croton hastatum* (l.c. t. 63, fig. 1) by the circumstance that the latter was collected at Surat, the former in Java. Later authors have at times been impressed by another difficulty when dealing with these two figures, owing to their being aware of the fact, apparently unknown to Burmann, that the plant which he has figured from a Java specimen is not a native of that island. The passages already quoted from Garcin's own journal show, however, that the difficulties experienced by Burmann and his critics are imaginary. The figure of *Croton tinctorium*, Burm. f. non Linn., represents a plant raised in a garden at Batavia from seed collected at Surat in 1723, still so young when it was collected that it had not lost the characteristic first pair of leaves or developed the shape and lobing characteristic of the leaves of a fully grown plant; the figure of *Croton hastatum*, Burm. f., non Linn., represents the upper portion of a fully developed plant of the same species gathered at Surat in 1724.

We do not know whether Garcin gave these specimens, or if he only lent them to Burmann. We may suspect that they were only lent, because they are not in the Burmann herbarium now. In that herbarium, however, there still are two specimens of this species. One of them was sent to Burmann as 'Croton arvense, Koen. Nelle-tschendi. Koenig n. 463.' The other was collected by Sonnerat, also in South India. We know that Koenig did not send his specimen to Burmann until after the publication of Burmann's work, for Koenig did not land in India till 1768. But we do not know whether Koenig sent that specimen to Burmann before or after the despatch of the specimen which reached Linnaeus, nor do we know why Koenig used different names for these two specimens of the same species. The field number, however, suggests that the specimen sent to Burmann was collected before 1774, while Koenig was still an officer in the service of the King of Denmark and before his transfer to that of the Nawab of Arcot. We know, too, that after 1778, when he entered the service of the East India Company, he changed the name of the species a second time; the specimens he gave to his friend Roxburgh, whose career under the Madras Government began in the same year as his own, bore the name *Croton asper* (or *asperum*), published for the first time, without description, in 1814 (*Roxb. Hort. Beng.* p. 104).

It may be that when Burmann passed the proof of his figure of *Croton hastatum*, he was under the impression that the plant depicted really was *Croton hastatum*, Linn. The fact that the plate is so inscribed has led Müller to remark (*DC. Prodr.* xv. 2,

p. 747) that the epithet 'hastatum' therefore has priority for this species. Notwithstanding the acceptance of this view by Pax and Hoffmann (*Pflanzenr.* IV. 147, iv. p. 19), this can hardly be the case. The basis of *Croton hastatum*, Linn. (*Sp. Pl.* p. 1005) is the 'Ricinus asperior alceae venetae foliis aliquatenus accedens' of Plukenet (*Almag.* p. 320, t. 220, fig. 2). That plant is *Tragia cannabina*, Linn. f., by some authorities regarded as only a variety of *T. involucrata*, Linn. But apart from this fact there is another consideration. Whatever Burmann may have thought when he passed the proof of his engraving, we know that when the corresponding text was printed (*Flor. Ind.* p. 305 [205]) he regarded *Ricinoides malabarica surattensis*, Garcin, as different from *Croton hastatum*, Linn.; he named Garcin's plant '*C. hastatum* β.'

During his journeys in 1761-62 Forskål collected specimens of four forms of *Chrozophora*. One of the four was the 'Tournesol' itself; a specimen of this, written up by Forskål as *Croton tinctorium*, is now in the British (Natural History) Museum. The indication 'ex Oriente' has been added to the sheet by another hand. This specimen is not referred to in the 'Flora Aegypto-Arabica' edited by Zoega in 1775. No doubt the specimen *may* have been collected in Egypt; the 'Tournesol' has often been found near Cairo. But Forskål also made a collection near Marseilles, and this British Museum specimen of *Chrozophora tinctoria*, A. Juss., is just as likely to have been gathered in the Bouches du Rhône and omitted from Forskål's Marseilles list as to have been obtained near Cairo and left out of the Egyptian one.

The references by Zoega to the other three gatherings made by Forskål are not quite satisfactory. Yet as two of them have become the basis of still valid species of *Chrozophora*, it is necessary to examine them all with care. Two of the three are enumerated in the Egyptian portion of the work (*Fl. Aegypt.-Arab.* p. lxxv.), as '490. Croton tinctorium' and '491. Croton argenteum' respectively; the third is in the Arabian portion (l.c p. cxxxi.), as '563. Croton tinctorium?' The doubt expressed by Forskål with regard to the identity of his Arabian plant is justified. His type, duly written up, is in the Copenhagen herbarium. It was gathered at Lohaja; it is a member of the group γ Tinctoriae. But it is not the 'Tournesol'; it is the shrubby *Chrozophora*, plentiful on the Red Sea littoral, which Isnard had erroneously referred to Lippi's 'Ricinoides memphiticus folio laevi.'

The identifications proposed by Forskål for the two Egyptian species are as imperfect as that suggested for the Arabian one. The specimen of '491. Croton argenteum,' duly written up in the Copenhagen herbarium, bears little resemblance to the true *Croton argenteum*, Linn., which is the South American plant now known as *Julocroton argenteus*, Didr.

Nor is the treatment of '490. Croton tinctorium' much better. In the descriptive section of the 'Flora' (*Cent.* vi. p. 162) caution has been enjoined; there the species is described as 'Croton tinctorium?' The type specimen, which was collected at Gizeh and is duly written up in the Copenhagen herbarium as 'C. tinc-

torium Forsk. Cent. vi. p. 162 ', has stellate-pubescent capsules, and therefore cannot be *Croton tinctorium*, Linn., in which the capsules are lepidote.

Forskål's name *Croton argenteum*, which had no accompanying description, bears the relationship to the plant with which Forskål associated it, that Müller imagined to subsist between *Croton hastatum*, Burm. f. non Linn., and *Ricinoides malabarica surattensis*, Garcin. In this case, however, neither Müller nor Pax and Hoffman have claimed that the epithet ' argenteum ' has priority.

In 1786 Lamarck, under *Croton*, dealt in intention with only two, in practice with three, species of *Chrozophora*. One of these was the Tournesol, *C. tinctorium*, Linn. (*Encyc. Meth.* iii. p. 214). In the Lamarck herbarium there is one specimen which Lamarck has written up:—' un rameau du Croton tinctorium. Tournesol d. Vahl.' There is nothing to show whether this specimen had been given by Vahl to Lamarck before or after the publication of the third volume of the Encyclopædia. While the ' Tournesol ' itself has been treated by Lamarck as it was by Linnaeus, the treatment of 1753 has been departed from by the addition of two varieties. The inclusion of these was the result of Burmann's action in 1768. Lamarck appreciated, what Burmann failed to observe, that *Croton tinctorium*, Burm. f. non Linn., and *C. hastatum*, Burm. f. non Linn., are forms of the same species. But Lamarck, like Burmann, failed to observe that this species with stellate-pubescent capsules cannot be *C. tinctorium*, Linn., in which the capsules are lepidote. Lamarck regarded *C. hastatum*, Burm. f. non Linn., as ' C. tinctorium β,' citing *Burm. Fl. Ind.* t. 63, fig. 1 in the text, and writing up a specimen in his herbarium, which agrees exactly with that figure, as ' Croton hastatum Burm. Fl. Ind. t. 63, f.1. Croton tinctorium var. β enc.' The locality and the collector of this specimen are not mentioned. Under ' C. tinctorium γ ' Lamarck in his text has cited *Burm. Fl. Ind.* t. 62, fig. 1, while in his herbarium there are four specimens of the same species, which hardly differ from the representative of his var. β. These specimens Lamarck has written up as ' Croton tinctorium de Mr. Sonnerat. var. γ enc.'

The other species of *Chrozophora* described by Lamarck is *Croton senegalense* (*Encyc. Meth.* iii. p. 212), based by citation on a specimen referred to as ' No. 165 A. Pardath.' There is no example of *C. senegalense* in the Lamarck herbarium. In the Jussieu herbarium, however, we find evidence that while travelling in Senegal between 1749 and 1753 Adanson obtained three distinct gatherings of two somewhat different forms of *Chrozophora* to which he gave the field-numbers ' Herb. de Galam 60,' ' Herb. de Galam 61,' and ' No. 145.' The general facies of all three is the same, but whereas ' Herb. de Galam 60 ' has the undersurface of the leaves softly woolly with long-stalked stellate hairs, the other two specimens, ' No. 145 ' and ' Herb. de Galam 61,' agree with each other, and differ from ' Herb. de Galam 60 ' in having the leaves adpressed-hoary beneath with sessile stellate hairs. Of these three specimens it is to ' Herb. de Galam 60,'

with softly woolly leaves, that the original description of *Croton senegalense*, Lamk, applies. Yet it is one of the two with leaves adpressed-hoary on the undersurface which Lamarck has cited as his type, and the example of 'Adanson n. 145' in the Jussieu herbarium has been written by Lamarck himself as 'Croton senegalense Lamk encycl.' The specimen which agrees with Lamarck's description bears no endorsement in Lamarck's handwriting; beyond the words 'Herb. de Galam 60', written by Adamson, it only has the word 'Croton' written by A. L. Jussieu. The plants represented by this specimen and by 'Adanson n. 145' are certainly closely related. This, however, does not alter the fact that, under *Croton senegalense*, Lamarck has described one plant and cited another as the basis of his species.

In 1790 Vahl (*Symb. Bot.* p. 78), dealt more satisfactorily than Zoega did in 1775 with the two species of *Chrozophora* collected by Forskål in Egypt. The one which in Forskål's list stood as '490. Croton tinctorium,' Vahl described as *Croton plicatum*, and the actual specimen at Copenhagen which bears the legend 'C. tinctorium Forsk. Cent. vi. p. 162,' has been written up by Vahl as *C. plicatum*. By some inadvertence, however, Vahl, when describing this species, either failed to note that it had been collected at Gizeh, or failed to realise that Gizeh is in Egypt. By giving 'Arabia,' where *C. plicatum* has never yet been collected, as the home of the species, Vahl has led more than one subsequent author astray. The plant, which in Forskål's Egyptian list stood as '491. Croton argenteum,' Vahl described as *C. obliquum*; the actual specimen which is the type of *C. argenteum*, Forsk. non Linn., in the Copenhagen herbarium has been written up by Vahl himself as *C. obliquum*. Vahl does not appear, however, to have suspected that *C. obliquum* is the species which Tournefort in 1703 had characterised as 'Ricinoides ex qua paratur Tournesol gallorum, folio oblongo et villoso.'

Whatever the explanation of Vahl's error in regarding *C. plicatum* as an Arabian plant may have been, we know that this error was not due to any confusion by Vahl between the plant collected at Gizeh which Forskål named *C. tinctorium* and the plant collected at Lohaja in Arabia to which Forskål gave the same name. It is true that Vahl did not take up '563. Croton tinctorium?' in the 'Symbolae.' It is also true that one of the two examples of this gathering now in the Copenhagen herbarium, which originally formed part of the Schumacher herbarium, was not written up by Vahl. But the other example of the Lohaja plant at Copenhagen bears the name, in Vahl's handwriting, 'Croton tinctorium F.' This endorsement shows that Vahl was aware of the treatment Forskål had proposed for this plant, and suggests that Vahl realised that it is different from *C. tinctorium*, Linn.

In 1794 the brothers Russell published a list of Aleppo plants (*Aleppo* ii. p. 265) one of these plants being *Croton tinctorium*, Linn. Their specimens, now in the British (Natural History) Museum, show that they included under the species at least one specimen which, while closely allied to, yet differs specifically from the true 'Tournesol' figured by Clusius and Gesner.

Willdenow in 1805 included in *Croton* (*Sp. Pl.* iv. 1, pp. 538-554) six species of *Chrozophora*:—20, *tinctorium*; 21, *plicatum*; 22, *obliquum*; 23, *verbascifolium*; 59, *moluccanum*; 67, *senegalense*. Two of these, *C. tinctorium* and *moluccanum* were, in intention, taken up from Linnaeus (1753); one, *C. senegalense*, was taken up from Lamarck (1786); two more, *C. plicatum* and *obliquum* were taken up from Vahl (1790); the last, *C. verbascifolium*, was based on Tournefort's *Ricinoides ex qua paratur* Tournesol *gallorum, folio oblongo et villoso* (1703).

In dealing with *C. tinctorium* (l.c. p. 538) Willdenow discarded the varieties proposed by Lamarck in 1786, but added to the Linnean citations of 1753 that of *Heliotropium minus*, as figured by Gesner, and as understood by Camerarius.

In discussing *C. plicatum* (l.c. p. 538) Willdenow was less successful. In theory and by description *C. plicatum*, Willd. is also *C. plicatum*, Vahl (1790), a prostrate Egyptian species with pink petals, violet-purple capsules, and red stigmas. But Willdenow never saw a specimen of *C. plicatum* and apparently did not compare Vahl's account with that of Zoega. Had he seen the true *C. plicatum* he might have refrained from associating with it the Indian prostrate plant with yellow petals, greyish-black, non-tinctorial capsules and orange stigmas which in the Willdenow herbarium still stands as the type of *C. plicatum*, Willd. non Vahl. Had he consulted Zoega he might have corrected Vahl's statement that the type of *C. plicatum*, Vahl, had been collected in Arabia. The type of his own *C. plicatum* was a plant sent to him as *C. plicatum* by Klein, who had found it at Tiruvalur, near Madras; that of Vahl's *C. plicatum* was gathered by Forskål at Gizeh in Egypt. Willdenow further marred our conception of *C. plicatum* by citing under Vahl's species the erect Indian plant with yellow petals, red-purple stellate-pubescent capsules and red stigmas which Burmann in 1768 had identified, and Lamarck in 1786 had associated with *C. tinctorium*, Linn. This confusion is made more perplexing owing to Willdenow having described this erect member of the *Plicatae* group on another page and under another name.

In dealing with *C. obliquum* (l.c. p. 539) Willdenow again had no opportunity of examining Vahl's type. Had Willdenow seen that type, which is also the type of *C. argenteum*, Forsk. non Linn., he could have ascertained that *C. obliquum* is the same thing as *Ricinoides ex qua paratur* Tournesol *gallorum, folio oblongo et villoso*, Tournef., and might have refrained from describing Tournefort's species afresh as *C. verbascifolium* (l.c. p. 539).

The least satisfactory, as regards citation, of the species described by Willdenow is *C. moluccanum* (l.c. p. 551). Both by references and by distribution *C. moluccanum* Willd. is also *C. moluccanum*, Linn. The plant upon which Linnaeus based that species was collected by Hermann in Ceylon. The type is still in the Hermann herbarium; it belongs to the species now known as *Givotia rottleriformis*, Griff. That species is not entitled to the epithet 'molucanna'; the plant does not occur in the Moluccas. We know that Linnaeus had no knowledge of this

plant when he named it; there was no specimen in his herbarium, written up as *Croton moluccanum*, in 1753. We know too that Linnaeus never became acquainted with the species; the specimen he did write up as *Croton moluccanum*, which was added to his herbarium some time between 1755 and 1767, belongs to the plant now known as *Mallotus moluccanus*, Müll.-arg. But if Linnaeus thus originated a double confusion, he was emulated by Willdenow in 1805. In the first place Willdenow has written up two different covers as *Croton moluccanum*. In one case the solitary specimen in the cover represents the *Aleurites* described by Willdenow (l.c. p. 590) as *A. moluccana*, Willd. The other cover (Herb. Willd. fol. 17891), however, has had written upon it by Willdenow the published diagnosis of *Croton moluccanum* with the additional note 'habitat in India' in substitution of the published habitat. The cover contains three specimens of the same species of *Chrozophora*. One of the three was sent by Roxburgh to Willdenow as *C. asper;* the other two were sent by Klein to Willdenow as *C. plicatum*. One of the two sent by Klein has smaller and less lobed leaves than the other. The description is brief but clear; it alludes to the variability of this species, more herbaceous in cultivated ground, more woody and with smaller leaves in waste places. The account of the capsules is exact. But Willdenow did not observe that this plant so well described by him is the species figured under two different names by Burmann and referred to *C. tinctorium* as two distinct varieties by Lamarck. This is the more singular, since his judgment as regards the specimens of the two different species sent to him by Klein under the name *C. plicatum* was so just.

In dealing with *C. senegalense*, Willdenow (l.c. p. 554) adopted Lamarck's treatment, apparently without suspecting that Lamarck had described one plant and quoted another.

In 1807, Geiseler, one of Vahl's pupils, published at Vahl's suggestion as a thesis for his degree as Doctor, a monograph of the genus *Croton* as then understood. It was prepared in Vahl's herbarium (*Geis. Crot. Monogr.* pref. p. iv.) with the help of Vahl's specimens and notes. It is, however, clear, from internal evidence, that Geiseler had no opportunity of consulting the specimens used by Burmann, Lamarck and Willdenow. Again there are six species that belong to *Chrozophora*:—70, *senegalensis*; 87, *Rottleri*; 110, *tinctorius*; 111, *plicatus*; 112, *obliquus*; 113, *verbascifolius*.

In dealing with *Croton senegalensis* (l.c. p. 45) Geiseler has supplied a new description of the species. This description, we are told, was drafted by Vahl in the herbarium of Jussieu. We have seen that the original description by Lamarck was based on a specimen in the Jussieu herbarium, but that Lamarck cited as his type a different specimen, also in the Jussieu herbarium. On seeing these specimens during a visit to Paris, Vahl detected Lamarck's error. Instead of accepting the description drafted by Lamarck and citing as Lamarck's type the specimen to which that description applies, Vahl chose to accept as the type of *C. senegalense* the plant cited by Lamarck, and to prepare a new description which is applicable to that plant.

In the case of *C. Rottleri*, Geiseler (l.c. p. 54) described as new a species of which a specimen had been sent to Vahl by Rottler from Southern India. The species was not a new one because the specimen on which it was based represents the shrubby condition of the plant described by Burmann in 1768 both as *C. tinctorium*, Burm. f. non Linn. and as *C. hastatum* β, Burm. f. non *C. hastatum*, Linn.; again described by Lamarck in 1786 both as *C. tinctorium*, var. β and as *C. tinctorium*, var. γ; and described a third time by Willdenow in 1805 as *C. moluccanum*, Willd. non Linn. Since, however, none of these earlier names is valid, Geiseler's name is that accepted for this species.

In dealing with *C. tinctorius*, Geiseler (l.c. p. 68), by excluding the reference, interpolated by Willdenow, to the figure by Gesner of a plant raised at Padua a century and a half earlier from seed received from Crete, reverted to the Linnean treatment of the Tournesol in 1753.

In dealing with *C. plicatus*, Geiseler (l.c. p. 70) was able to point out that *C. plicatum*, Vahl (*Symb.* p. 78), and *C. tinctorium*, Forsk. (*Cent.* vi. p. 162) non Linn., are names based upon the same specimen. The opportunity he had of studying that specimen enabled Geiseler to supplement Vahl's description by adding that in this species the capsules are stellate-pubescent. Notwithstanding his care, however, Geiseler omitted to correct Vahl's statement that the specimen had come from Arabia. Geiseler's citation of the prostrate Indian species which is the basis of *C. plicatum*, Willd. non Vahl, was the result of his acceptance of Willdenow's identification without having seen Willdenow's specimen. The citation of *C. tinctorium*, var. γ, Lamk, was due to want of opportunity to examine the Lamarck herbarium. Had Geiseler seen the Sonnerat specimens in Lamarck's collection he would have realised that they belonged, not to *C. plicatum*, Vahl, but to his own *C. Rottleri*.

In dealing with *C. obliquus*, Geiseler (l.c. p. 71) was again able, from an examination of the actual type, to supplement Vahl's original description by adding that in this species the capsules are lepidote. In this case the absence of an opportunity of examining the Willdenow herbarium prevented Geiseler from ascertaining that *C. verbascifolium*, Willd., which he has accepted as a valid species (l.c. p. 71), is *C. obliquum*, Vahl, under another name.

The disadvantage due to want of access to the Willdenow herbarium was even greater in the case of *C. moluccanum*, Willd. non Linn., seeing that this species, as described by Willdenow, includes the form described by Geiseler as *C. Rottleri*. Under the impression that the *Croton moluccanum* of Willdenow must be also *C. moluccanum*, Linn., Geiseler (l.c. p. 82) transferred the latter to *Aleurites*, as *A. commutata*, Geisel. Fortunately Geiseler, while justified in concluding that *C. moluccanum*, Linn., cannot be a *Croton*, was not justified in regarding it as an *Aleurites*. Had his conclusion been valid a new difficulty might have arisen, seeing that the species which he proposed to name *A. commutata* was published as *Croton moluccanum* on a page prior to that on which the plant which Geiseler was prepared

to accept as *A. moluccana* had been published as *Jatropha moluccana*, Linn.

In 1812 Delile (*Descr. Égypt. Hist. Nat.* ii. *Flor. Égypt.* p. 139, t. 51, fig. 1) described and figured as *Croton oblongifolium* a plant collected by him at Ajeraud near Suez. This was the first valid name for a species which had already been obtained on two occasions; this is the plant in the Jussieu herbarium which Isnard a century earlier had wrongly identified with Lippi's 'Ricinoides memphiticus folio laevi,' and is also the species collected in 1762 at Lohaja in Yemen by Forskål in whose Arabian list it stands as '563. Croton tinctorium?'

In 1813 Sibthorp and Smith (*Fl. Gr. Prodr.* ii. p. 249) described as a new species, *Croton villosus*, the plant which in 1703 Tournefort has described as 'Ricinoides ex qua paratur Tournesol gallorum, folio oblongo et volloso,' which Vahl had described in 1790 as *C. obliquum*; and Willdenow had again published in 1805 as *Croton verbascifolium*. The same form, when discovered for the first time in Spain, was published once more by La Gasca in 1816 (*Gen. et Sp. Nov.* p. 21) as *Croton patulus*.

In 1814, a year after Roxburgh had left India, Carey published Roxburgh's garden list. That work consists of two parts, the first devoted to living plants in the Calcutta Botanic Garden; the second to plants known to Roxburgh but not yet introduced. In the first portion Roxburgh had entered *Croton plicatum* (*Hort. Beng.* p. 69); in the second *Croton asperum* (l.c. p. 104). Roxburgh's larger descriptive work, which was also left in manuscript with Carey, though not published until 1832, was eventually printed exactly as it had stood in 1813. In this work we find (*Flor. Ind.* iii. p. 681) that Roxburgh knew that *C. asperum*, Koenig, was the same plant as that which he believed to be *C. plicatum*, and at the same time was identical with *C. tinctorium*, Burm. f. (1768) non Linn. Roxburgh's belief that it was *C. plicatum* was derived from Willdenow, a circumstance which proves that Willdenow had not informed Roxburgh that the specimen of *C. asperum* which he had sent to Willdenow had been treated as part of the basis of *C. moluccanum*, Willd. non Linn.

In a prospectus issued by Sieber in 1821 there are three references under *Croton* to species of *Chrozophora*. These call for attention because they are very generally cited by later authors. The first (*Avis des plantes*, p. 5) relates to *Croton tinctorium*, Linn. from Girapetro, in Crete. The specimens are not exactly like the 'Tournesol' of Southern France figured in 1557 by Clusius. They do, however, agree closely with the plant mentioned by Gesner in 1561 as having been raised at Padua from Cretan seed, and figured by him. The other two references (l.c. p. 7) are both to *C. plicatum*, Vahl, one of them noted in the Egyptian list, the other in the Palestine one. But the specimens show that the two plants are different; that from Egypt has stellate-pubescent capsules, and is nearly related to *C. plicatum*, Vahl; that from Palestine, where it was gathered in the garden of Gethsemane, has lepidote capsules, and somewhat resembles, though it does not quite agree with, the Cretan plant cited as *C. tinctorium*. After the issue of this prospectus, but before the distribution of the

corresponding specimens, Sieber discovered his error, and the printed labels issued with the plant from Gethsemane bore the name *Croton oblongifolium*. This was a new inadvertence, because *C. oblongifolium*, Del. does not occur in Palestine. But the use of the name *C. oblongifolium*, Sieb. (1821) non Del. (1812), is the first recognition of this plant as a distinct form.

In 1824 appeared the brief but important summary by the younger Jussieu (*Euphorb. Gen. Tent.* pp. 27, 28, t. 7, fig. 25/1-11). This revindicated the generic status of *Chrozophora* but in so doing it only transferred by name the Tournesol itself, in connection with his plate, to Necker's genus. Jussieu cited, as illustrating the genus, the various species of *Croton* which he believed to belong to *Chrozophora*, but left to those who might follow him the task of deciding what names these species ought to bear under *Chrozophora*. After defining the genus, Jussieu remarked.—Species circiter 8, duae senegalenses, caeterae ex Arabia aut Africa boreali quarum duae in Europâ australi crescunt; inter quas scilicet *Croton tinctorium*, Linn.; *C. obliquum*, Vahl; *C. plicatum*, Vahl; *C. verbascifolium*, Willd.; *C. oblongifolium*, Delile; *C. senegalense*, Lamk. Quibus ex descriptione forsan congeneres *C. mollissimus*, Geis. et *C. Rottleri*, Geis., alter sinensis, alter indica.

These carefully weighed statements of A. Jussieu can only be fully appreciated if the specimens in the Jussieu herbarium be examined. These specimens are arranged under seven consecutive numbers, 16262-16268.

Herb. Jussieu 16262 includes two specimens, 'Adanson n. 165' and 'Herb. de Galam 61.' The two belong to the same form. The one marked 'Adanson n. 165' is by citation the type of *Croton senegalense*, Lamk; it has been written up by Lamarck himself as 'Croton senegalense, Lamk encycl.' and has been further inscribed by A. L. Jussieu (but not by A. Jussieu) as 'Crozophora senegalensis Ad. J. Euph. 28,' although the entry on the page cited really is 'Croton senegalense, Lamk.'

Herb. Jussieu 16263 includes two specimens of *Croton tinctorium*, Linn., neither of them localised and neither with a collector's name.

Herb. Jussieu 16264 consists of one specimen only, without locality or collector's name. Its chief interest is that it has been written up by Vahl, when he examined the Jussieu herbarium, as 'Croton obliquum.' The specimen is exactly like the one at Copenhagen which was named *Croton argenteum* by Forskål, and was later made the type of *Croton obliquum*, Vahl (1790).

Herb. Jussieu 16265 consists of one specimen only, which is interesting because neither A. L. Jussieu nor A. Jussieu, nor Lamarck nor Vahl when they examined the herbarium, ventured to name it. It originally belonged to Danty d'Isnard, who wrote it up as 'Ricinoides memphiticus folio laevi, Lippi.' As has already been explained, a later note in an unknown handwriting has explained that it cannot be the plant Lippi had in mind. The specimen is one of *Croton oblongifolium*, Del.

Herb. Jussieu 16266 consists of one specimen, collected in Senegal by Adanson, whose note is:—'Herb. de Galam 60.' This

is the specimen on which the description of *Croton senegalense* published by Lamarck was based, though it is not the specimen cited by Lamarck as the type of his species. Vahl, when he examined the Jussieu herbarium, discovered the transference which Lamarck had inadvertently made. To rectify matters Vahl prepared a new description of *Croton senegalense*, based on 'Adanson n. 165.' This description, we have seen, he permitted Geiseler to publish in 1807. Neither A. L. Jussieu, A. Jussieu, Lamarck, nor Vahl gave this plant a specific name. It bore, when they studied it, only the word 'Croton'; at a later date Desvaux added to the generic name the indication 'senegalense var. β. Desv.' The chief interest of the specimen is that it was the basis of the second of the 'species duae senegalenses' referred to by A. Jussieu.

Herb. Jussieu 16267 consists of two specimens, rather badly prepared, of the herbaceous condition of *Croton Rottleri*, Geis. The chief interest of these specimens is that they have been written up by Vahl himself, as Baillon has already stated (*Étud. gén. Euphorb.* p. 322), as 'Croton plicatum, Vahl.' To this indication A. L. Jussieu has added the word 'Symb.' and has at the same time written 'Crozophora plicata, Ad. J. Euph. 28.' A secondary interest attaches to this evidence that Vahl, when he visited Paris, was unable to discriminate between this erect, long-racemed Indian plant and the prostrate, short-racemed Egyptian one which he believed to have been gathered in Arabia. These specimens of *Croton Rottleri* have attached to them two palm-leaf labels, which, unfortunately, tell us no more than that the specimens were gathered in Southern India. Even this information is indirect. The writing on the labels is in Tamil, but in both cases the inscriptions, which contain the name 'Rama,' are apparently catchwords from the edge of some manuscript.

Herb. Jussieu 16268 consists of two specimens, both representing the same condition of the same species. One of the specimens bears three labels written up by Gundel, Tournefort, and Vaillant respectively. The label by Gundel is endorsed 'ex insula Melo.' That written up by Tournefort reads, 'Ricinoides ex qua paratur Tournesol gallorum folio oblongo et villoso,' so that we are left free from doubt as to the plant intended by that name as published in 1703 (*Cor.* p. 45). The second specimen bears two labels, one of these endorsed 'Croton verbascifolium, Willd.' It is possible that the specimen may have been received from Willdenow himself, for underneath the original name A. L. Jussieu has written 'Crozophora verbascifolia Ad. J. Euph. 28.' The second label, however, is more interesting; it is in the handwriting of Adrien Jussieu himself, who has endorsed it 'Croton obliquum,' an identification which, under the circumstances, was fully justified, because the specimen agrees well with the one in Herb. Jussieu 16264, named *Croton obliquum* by Vahl himelf. This endorsement perhaps explains the younger Jussieu's statement, not so fully appreciated as it deserves, that two of the North African species of *Chrozophora* extend to Europe. One of the two is the 'Tournesol' itself, which is to be met with everywhere on or near the Mediterranean seaboard; the other is *Croton obliquum*, Vahl, which, until A. Jussieu wrote, had been looked upon as

exclusively African, the name *C. verbascifolium*, Willd., having become established for the same species when collected in Europe.

As regards the two species which he only knew from description, Jussieu was not so fortunate. The Chinese one, *Croton mollissimus*, Geisel, we now know not to be a *Chrozophora*; it is the plant described by Müller as *Mallotus ricinoides*, Müll.-arg. Misled by Vahl, who had referred the specimens of *Croton Rottleri* in the Jussieu herbarium to *C. plicatum*, Jussieu did not discover that he had at his command material of the doubtful Indian species. At the same time, and for the same reason, he misinterpreted *Croton plicatum*, Vahl, there being no example of that prostrate African species in the Jussieu herbarium. Finally, though that herbarium did contain an example of *Croton oblongifolium*, Del., Jussieu did not realise the fact. His citation of that species was based upon Delile's description and figure.

In 1830 the task of distributing the specimens of *Chrozophora* which had accumulated in the East India House was carried out by Wallich. These specimens were aggregated under one entry (*Wallich, Cat. Lith.* 7716) subdivided into nine sections (A.-I.). Though less important than the corresponding specimens in the Jussieu herbarium because they never became the basis of a literary contribution to the study of the genus, they are nevertheless of some consequence owing to the frequency with which they have been cited. For this reason it is desirable to explain precisely what they are.

'77716 A. Croton tinctorium, Herb. Roxb.' The name of this specimen was written up by Roxburgh. The specimen represents the herbaceous condition of *Croton Rottleri*, Geis.

'7716 B. Herb. Heyne.' This includes two specimens, with neither name nor locality. One is *Croton Rottleri*, Geis., and this specimen matches very closely various specimens in other herbaria, some of which were collected by Heyne in Mysore, others in the Carnatic. The second specimen represents a prostrate plant with the habit and general facies of *Croton plicatum*, Vahl, from Egypt, but it has grey or blackish in place of violet-purple ripe capsules. As regards its capsules it agrees with the plant from Tiruvalur, sent by Klein to Willdenow, which is the basis of *C. plicatum*, Willd. non Vahl, but it differs from the Tiruvalur plant in having the leaves eglandular at the base and softly woolly with long stellate hairs. A duplicate of this gathering in the Rottler herbarium shows that it was collected by Heyne in Mysore in May, 1800. This is the first appearance of this particular form, which was unknown to Burmann, or Lamarck, or Vahl, or Geiseler, or Willdenow.

'7716 C. Cr[oton] plicatum e Patna, et Cr[oton] asperum e Dhomdoha; Herb. Hamilt.' These two specimens were collected by Buchanan (known after 1816 as Hamilton) during the economic survey of Bengal conducted by him in 1807-14. The plants then collected were sent to the East India House, London, in 1815; they were handed to Hamilton to be worked out in 1820; they were returned to the East India House, with a detailed report, in 1822. This manuscript was not published by the East India Company. The two names given represent, none the less, the

mature conclusion of one of the ablest of Indian botanists. The plant named *C. plicatum*, Ham., is the same as the prostrate plant collected by Heyne in Mysore in 1800; that named *C. asperum* is the herbaceous condition of *C. Rottleri*, Geis.

'7716 D. Cr[oton] plicatum e Pierwandy et Madras; Hb. Wight.' These two specimens were collected by Wight early in his Indian career, which opened in 1819. They represent the same two plants distributed under 7716 C. The Pierwandy plant is *C. plicatum*, Ham. non Vahl, nec Willd., nec Roxb. The Madras plant is the herbaceous state of *C. Rottleri*, Geis.

'7716 E. Cr[oton] plicatum, Herb. Madr.' Neither locality nor collector's name accompany this specimen. We know, however, from other sources that many of the specimens belonging to the 'Madras herbarium' were collected by Rottler. This particular specimen is the shrubby condition of *Croton Rottleri*, Geis., and may well be a cotype of that species. If this be not the case, the origin of the plant sent by Rottler to Vahl cannot be traced with precision. It does not, however, follow that it was actually collected by Rottler; although most of the plants in the 'Madras herbarium' were of his own gathering, some were obtained by him from other botanists. In the private Rottler herbarium we find only three specimens of *Chrozophora*; none of these were collected by Rottler himself. One is the specimen, already mentioned, of the prostrate Indian species with eglandular leaves, which Heyne collected in Mysore. Another is the herbaceous condition of *Croton Rottleri*, Geis., which Roxburgh sent to Rottler from Calcutta. The third is the shrubby condition of the same species from a specimen of which Geiseler prepared his description. This last specimen is so like Wallich's n. 7716 E. that the two might well belong to the same gathering. It matches also very closely one of the specimens from South India in the cover containing *Croton moluccanum*, Willd. non Linn., in the Willdenow herbarium. Like the specimen in the Willdenow herbarium, that in the Rottler herbarium was collected by Klein, who had gathered it at Devanur. It is therefore not impossible that Wallich n. '7716 E. Herb. Madras' may also have been gathered by Klein.

'7716 F. Cr[oton] asperum Herb. Russ.' This specimen was collected by Dr. Patrick Russell, F.R.S., and therefore, as we know from other sources, came from the Northern Circars. The plant is the herbaceous condition of *C. Rottleri*, Geis.

'7716 G. Hindustania.' This specimen has been cited by Müller (DC. Prodr. xv. 2. p. 749) as having been collected by Wallich. Other authors have copied Müller. The label with the indication 'Hindustania' was, however, written by Roxburgh. The field-note, on the other hand, was written by Hardwicke, and indicates that the plant was collected at Bindraban, a sacred city on the Jumna close to Mattra. It came, therefore, from a locality which neither Roxburgh nor Wallich ever visited, and one to which neither of these botanists ever sent their own collectors. The chief interest of this plant is that it is the first *Chrozophora* with lepidote in place of stellate-pubescent capsules to be found in India. Though closely allied to the 'Tournesol,' *Croton tinc-*

torium, Linn., it is not identical with the 'Tournesol,' but agrees with the plant from the Garden of Gethsemane which Sieber issued as *Croton oblongifolium* under the mistaken impression that it was the same as the Egyptian plant of that name described and figured by Delile. In distributing specimens of 7716 G., however, Wallich has inadvertently led various writers astray owing to his failure to realise the fundamental difference which the possession of lepidote or stellate-pubescent capsules respectively implies. The specimens of 7716 G. which have reached the British (Natural History) Museum and the Calcutta herbarium are duplicates of Hardwicke's plant from Bindraban, those sent to the Paris and the Delessert herbaria, and that now at Kew, belong on the other hand to the herbaceous condition of *Croton Rottleri*, Geis.

'7716 H. Cr[oton] polycarpum, H. B. Calc.' This also represents the annual herbaceous condition of *C. Rottleri*, Geis., which is so plentiful in Bengal. The authority for this particular name is unknown.

'7716 I. Pagham Mew, 1826.' This specimen again represents the herbaceous condition of *Croton Rottleri*, Geis. It was collected by Wallich himself at Paganmyo in Burma. It is not, however, the first record of the species from that country. There is a specimen in the British (Natural History) Museum which was collected at Kyouk Zeik in 1795 by Buchanan (afterwards Hamilton) when that officer was attached to the Embassy under Symes to the Burmese Court at Ava.

History of the Species, 1826–64.

While the genus *Chrozophora* was recognised anew by A. Jussieu in 1824, his treatment of its species was rather the last chapter of their history under *Croton*. Their history under Necker's genus opened in 1826 with a résumé by Sprengel (*Syst. Veg.* iii.) of ten species, eight of them attributed to Jussieu.

1. *Chrozophora senegalensis*, A. Juss. ex Spr., is *Croton senegalense* as treated by Geiseler in 1807.

2. *C. Rottleri*, A. Juss. ex Spr., is *Croton Rottleri*, Geis. (1807).

3. *C. oblongifolia*, A. Juss. ex Spr., is *Croton oblongifolium*, Del. (1812).

4. *C. plicata*, A. Juss. ex Spr., includes *Croton plicatum*, Vahl (1790) and *Croton plicatum*, Willd. (1805) non Vahl.

5. *C. hierosolymitana*, Spr., is *Croton oblongifolium*, Sieb. (1821) non Del., now for the first time provided with a name that is valid.

6. *C. tinctoria*, A. Juss. (1824), is the 'Tournesol.'

7. *C. obliqua*, A. Juss. ex Spr., is *Croton obliquum*, Sieb. (1821).

8. *C. verbascifolia*, A. Juss. ex Spr., is *Croton verbascifolium*, Willd. (1805).

9. *C. mollissima*, A. Juss. ex Spr., is *Croton mollissimus*, Geis. (1807) which is *Mallotus ricinoides*, Müll.-arg.

10. *C. Burmanni*, Spr. is *Croton hastatum* β., Burm. f. (1768).

In this list, therefore, we find evidence that Sprengel had not ascertained that *C. obliqua* and *C. verbascifolia* are merely different names for the same species, or learned that *C. Burmanni* is merely a somewhat different condition of *C. Rottleri*.

In 1834 Decaisne (*Flor. Sin.* p. 242) recorded *C. oblongifolia*, A. Juss. as collected by Bové in Sinai, an important indication, since the identification is accurate, that as yet no confusion had arisen with regard to the name of Delile's plant.

We have already discussed the considerations which may have led Visiani in 1836 to refer *Croton obliquifolium* (*Pl. quaed. Nilot.* p. 39, t. 7, fig. 2) and *Chrozophora Brocchiana* (l.c. t. 8, fig. 2) to different genera. Dealing with them as individual species, Visiani suggested that the former might be the same as *Croton tinctorium*?, Forsk. (*Cent.* vi. p. 162); it certainly is very near that plant, which is the type of *Croton plicatum*, Vahl (1790). Professor Saccardo informs us that there is not now at Padua any specimen written up by Visiani as 'Croton obliquifolium,' and the present whereabouts of Visiani's type cannot be traced. The same, Professor Saccardo has explained, is also unfortunately true as regards Visiani's second species, the description of which does not agree exactly with the corresponding figure. The plant described is clearly closely allied to the one described by Lamarck as *Croton senegalense*, but differs in having leaves softly woolly above as well as beneath, whereas in Lamarck's plant the leaves are nearly and at length quite glabrous above. The relationship of the various forms in the group *Senegalenses* will be dealt with in a subsequent paragraph.

In 1839 Fischer and Meyer (*Kar. Enum. Turc.* p. 171) named, without description, a new species, *C. gracilis*, from Turkestan. In 1841 Karelin and Kirilow (*Bull. Soc. Nat. Mosc.* xv. p. 446) described a new species, *C. sabulosa*, from Soongaria. In 1844 Presl (*Bot. Bemerk.* p. 109) described as *C. Sieberi* the plant that Sprengel in 1826 had named *C. hierosolymitana*. About 1850 Ledebour dealt with all three (*Fl. Ross.* iii. 2. p. 581) keeping *C. gracilis* and *C. sabulosa*, which are identical, as distinct species, but merging Caucasus specimens of *C. hierosolymitana* in *C. tinctoria*, A. Juss.

In 1851 Bunge (*Rel. Lehm.* p. 314) recognised *C. sabulosa* but not *C. gracilis*, and (l.c. p. 315) treated Turkestan examples of Sieber's plant as possibly distinct from *C. tinctoria*. At the same time Bunge re-described as a new species, *C. integrifolia*, what Sprengel had diagnosed as *C. obliqua*, A. Juss.

In 1851, also, Richard (*Tent. Fl. Abyss.* ii. p. 252) recorded *C. plicata*, A. Juss., from Abyssinia; all the specimens he dealt with are identical with *Croton plicatum*, Vahl (1790). But Richard collected in Lower Egypt specimens, which he identified with *C. plicata*, that agree with *Croton obliquifolium*, Vis. These specimens prove that as late as 1851 no author had regarded the plants of Vahl and Visiani as distinct.

In 1858 Baillon issued a list of nine species of *Chrozophora* (*Étud. gén. Euphorb.* p. 322). This list is rarely studied, perhaps because it has no descriptions. Under each of his species, how-

ever, Baillon has cited representative specimens which are more reliable than descriptions can possibly be. These species are :—

1. *Chozophora integrifolia*, Bunge, based on Lehmann's plant described by Bunge.

2. *C. sabulosa*, Kar. et Kir., based on Lehmann's plant cited by Bunge.

3. *C. tinctoria*, A. Juss., the 'Tournesol.'

4. *C. senegalensis*, A. Juss., which includes 'Adanson n. 165' the plant cited by Lamarck as the type of *Croton senegalense;* the plant collected by Adanson at Galam on which the description of *Croton senegalense* was based; and a specimen, 'Kotschy n. 25,' from Abu Gerad in Kordofan which agrees with 'Adanson n. 165' as regards tomentum on the under-surface of the leaf, but differs from both the Senegal plants of Adanson in having the leaves persistently shortly puberulous above.

5. *C. obliqua*, A. Juss., based on the plant in Herb. Jussieu written up by Vahl as *Croton obliquum*.

6. *C. oblongifolia*, A. Juss., represented by specimens collected by Bové and by Botta in Sinai, which agree with *Croton oblongifolium*, Del. (1812).

7. *C. verbascifolia*, A. Juss., which includes *Croton verbascifolium*, Willd. and, with this, three specimens collected by Aucher (2008, 5297 from Persia : 2006 from Syria), all of them belonging to *C. hierosolymitana*, Spr., as does another unlocalised specimen collected by Botta.

8. *C. plicata*, A. Juss., which includes the specimen of *Croton Rottleri*, Geis. in the Jussieu herbarium that Vahl wrote up as *Croton plicatum*, along with specimens from Abyssinia obtained by Quartin-Dillon and Petit that agree with the true type of *Croton plicatum*, Vahl, and with specimens from Egypt collected by Olivier and by Aucher that agree with the figure of *Croton obliquifolium*, Vis. To *C. plicata* Baillon has also referred a specimen without field note, which agrees with *Croton obliquifolium*, attributed on the herbarium label to Olivier and Bruguière, and stated to be from Syria.

9. *C. obliquifolia* [Vis.], Baill., based on a specimen of 'Kotschy n. 473,' from Wolet Medine in Sennar, which agrees with Visiani's figure of *Croton obliquifolium*.

In 1860 T. Anderson (*Fl. Aden.* p. 36) recorded *C. obliquifolia* from the coasts of the Red Sea and the Gulf of Oman. This record, which Anderson's specimens prove to be correct, is of interest as showing that at this late date no confusion had arisen as to the proper name of the species. In 1860 also, Baillon (*Adans.* i. p. 67) reverted to the forms from Senegal, recognising two species, one of them *C. senegalensis*, A. Juss., treated as Geiseler treated *Croton senegalense* in 1807; the other *C. plicata*, A. Juss., based on specimens collected at Dagana by Leprieur between 1824 and 1829 and on others collected near Lake Chad by Vogel in 1854. Some of Leprieur's specimens agree with *Croton plicatum*, Vahl; the others, and all those of Vogel, agree with

Croton obliquifolium, Vis. But Baillon has also identified with *C. plicata* the specimen collected by Adanson in Senegal on which Lamarck based his description of *Croton senegalense*, but which he did not cite. As the *Chrozophora* to which the specimen belongs has lepidote capsules, whereas the capsules of *C. plicata* are stellate-pubescent, this reduction proposed by Baillon cannot be adopted.

In 1861 Dalzell (*Fl. Bomb.* p. 233) carried out what Hamilton had proposed in 1822 and treated the erect Indian *Chrozophora* with stellate-pubescent red-purple capsules as distinct from the prostrate Indian one with eglandular leaves and blackish non-tinctorial stellate-pubescent capsules. But whereas Hamilton termed the erect species *Croton asperum* and the prostrate one *Croton plicatum*, Dalzell termed the erect species *Chrozophora plicata* and used for the prostrate one the new name *Chrozophora prostrata*.

In 1862 Schweinfurth (*Pl. quaed. Nilot.* pp. 10, 11, tt. 3, 4) carefully figured and separated the two forms described as *Croton plicatum* by Vahl in 1790 and as *Croton obliquifolium* by Visiani in 1836. In doing this Schweinfurth, after having examined the type of 'Croton tinctorium? Forsk. Cent. vi. p. 162' in the Copenhagen herbarium, rejected Visiani's suggestion that *Croton obliquifolium*, Vis., might be the form described by Forskål. Nevertheless, after having taken this step, Schweinfurth used for Visiani's plant the name *Chrozophora plicata*, in spite of the fact that the type of *Croton plicatum*, Vahl (1790), is the plant from Gizeh which Forskål had described as *Croton tinctorium*. For the plant with stellate-pubescent capsules which does agree with 'Croton tinctorium? Forsk. Cent. vi. p. 162' Schweinfurth used the name *Chrozophora obliqua*, notwithstanding the fact that in 1807 Geiseler had explained that the capsules of *Croton obliquum*, Vahl (1790) are lepidote.

Under the plant which Visiani had termed *Croton obliquifolium* in 1836 and which Baillon had named *Chrozophora obliquifolia* in 1858, but which Schweinfurth had now termed *Chrozophora plicata*, the last-named author in 1862 cited a specimen which Klotzsch in 1861 (*Peters, Mossamb. Bot.* ii. p. 99) had identified with *C. tinctoria*. In 1863 Klotzsch (l.c. *corrig.* p. 576) accepted Schweinfurth's emendation. This plant, Schweinfurth has remarked, does not extend to India.

But the plant which Schweinfurth had now termed *Chrozophora obliqua* was treated with less caution because it was made to include, in addition to the African form which agrees with the type of *Croton plicatum*, Vahl (1790), both the South India *Croton plicatum*, Willd. (1805), non Vahl, for which, Schweinfurth has told us, Klotzsch had suggested the name *Chrozophora parvifolia*, and the Bombay plant which Dalzell had named *Chrozophora prostrata*.

In the same work Schweinfurth (l.c. p. 9) has endeavoured to elucidate what Visiani had intended by *Chrozophora Brocchiana*, repeating (t. 5 *b*) from Visiani's plate the form which he assumed to be that meant by Visiani as his type, and depicting as a variety *Hartmanniana* (t. 5) one which better agrees with

Visiani's description. He also suggested that the Senegal plant with leaves woolly beneath with long hairs might be another variety of *C. Brocchiana*.

In 1864 Thwaites (*Enum. Pl. Zeyl.* p. 443) first, and alone among authors who had dealt with *Chrozophora* since 1807, used the name *C. Rottleri* for the plant described by Geiseler as *Croton Rottleri*, without confusing that plant with any other species.

Chrozophora in DeCandolle's Prodromus.

The important monograph of the genus by Müller in 1866 (*DC. Prodr.* xv. 2) has already been adverted to. The relationship to each other of the various forms recognised could hardly be improved. The limitation of some of the forms and their eclectic nomenclature are, however, less satisfactory. This is not because of the extreme reduction advocated; although Müller included all the forms of the *Plicatae* group in one species and all those of the *Tinctoriae* group in two species, he did not take advantage of this to shirk any of the issues involved; he carefully treated as distinct varieties the forms which earlier writers had regarded as separate species. Thus *C. plicata*, Müll.-arg. (l.c. p. 747) includes three varieties:—*a. Rottleri*, *β. genuina*, and *γ. prostrata;* while *C. tinctoria*, Müll.-arg. (l.c. p. 748) includes four varieties:—*a. verbascifolia*, *β. hierosolymitana*, *γ. genuina*, and *δ. subplicata*.

1. *C. plicata a. Rottleri* is treated naturally. It includes *Croton Rottleri* Geis. (1807); *Croton hastatum β.* Burm. f. (1768), which is the basis of *Chrozophora Burmanni*, Spr. (1826); *Croton moluccanum*, Willd. (1805), non Linn. It also includes *Croton tinctorium*, [Roxb. ex] Wall. (1830); *Croton asper.*, [Koen. ex] Wall. (1830); *Croton polycarpum*, [Hort. Calc. ex] Wall. (1830). All six names do, as the original specimens or their co-types show, belong to the same plant. But Müller has excluded from his *a. Rottleri* the Java *Croton tinctorium*, Burm. f. (1768) non Linn. which is only a cultivated condition of *Croton hastatum β.*; he has excluded *Croton asperum*, [Ham. ex] Wall. (1830), which is the same thing as *Croton asper*, Koen. (1814); he has also excluded *Croton plicatum*, Roxb. (1814) non Vahl, which, as Roxburgh explained in 1832, is the same thing as *Croton tinctorium*, Burm. f. on the one hand and *Croton asperum*, Koen. on the other. More perplexing still is the reference by Müller of *Croton asperum*, Ham., which by the actual type is his *a. Rottleri*, to his *β. genuina;* and the reference of *Croton plicatum*, Roxb., which also by its co-types is Müller's *a. Rottleri*, to his *γ. prostrata*. Misled by the employment by Willdenow of the epithet '*moluccanum*,' Müller has attributed a plant sent by Koenig from Devanur in Madras to the Moluccas, where no *Chrozophora* occurs.

1*b*. *C. plicata β. genuina*, believed by Müller to correspond with *Croton plicatum*, Vahl (1790) in reality carefully excludes Vahl's plant, since the variety has been based upon *Chrozophora plicata*, Schweinf. (1862) which is *Croton obliquifolium*, Vis. This variety, copying Schweinfurth, includes *C. tinctoria*, Klotzsch

(1861) non A. Juss. But Müller did not accept the conclusion of Schweinfurth that this African *Chrozophora* is absent from India, or accept the opinion of Schweinfurth that both of the prostrate Indian forms of this genus in which the capsules are stellate-pubescent belong to the same variety of *Croton plicatum*, Vahl. The former decision was less, the latter was more satisfactory than the conclusions of Schweinfurth, which they respectively contradict. What, however, is most perplexing in Müller's action is that, of the two prostrate forms of *Chrozophora* recognised by him, the specimens cited show that it is the one which Dalzell described as *C. prostrata* that Müller has referred to his variety β. *genuina*.

1c. *C. plicata* γ. *prostrata* we learn from Müller himself (l.c. p. 698) that he at first named γ. *obliqua;* we know therefore that in intention this corresponded with *C. obliqua*, Schweinf. (1862), non A. Juss. The variety includes the African *Croton plicatum*, Vahl (1790) and the Indian *Croton plicatum*, Willd. (1805) non Vahl, which is *Chrozophora parvifolia*, Klotzsch ex Schweinf. (1862). But by citation it further includes *Croton plicatum*, Roxb. (1814) non Vahl, which is really Müller's own variety *a. Rottleri*, as well as *Chrozophora prostrata*, Dalz. (1861), though the specimens of this latter plant are included in Müller's own variety β. *genuina*. By some inadvertence the plant on which *C. parvifolia*, Klotzsch, was based has been attributed to Malacca, whence no *Chrozophora* has yet been reported, although Klein really collected it at Tiruvalur, near Madras. A corollary to the reduction to his var. γ. *prostrata* of *Croton plicatum* Roxb., has been Müller's impossible reference to this particular form of *Croton tinctorium*, Burm. f., which was raised in a Java garden from Surat seed.

2. *C. sabulosa* (l.c. p. 748) is the plant described under this name by Karelin and Kirilow in 1842 and again by Bunge in 1851. The existence of *C. gracilis*, named but not described by Fischer and Meyer in 1839, and described as distinct from *C. sabulosa* by Ledebour in 1850, was not alluded to by Müller.

3. *C. tinctoria a. verbascifolia* (l.c. p. 748) is naturally delimited and includes *Croton verbascifolium*, Willd. (1805); *Croton villosus*, Sibth. & Sm. (1813); *Croton patulus*, La Gasca (1851) and *Chrozophora integrifolia*, Bunge (1851). All four names indicate the same plant, as Müller has stated. But Müller, though he rejected Schweinfurth's erroneous identification of *Croton obliquum*, Vahl (1790), failed to discover that Vahl's species is really the same thing as *C. verbascifolium*, Willd.

3b. *C. tinctoria* β. *hierosolymitana* (l.c. p. 749) is based on the specimen which is the type equally of *Croton oblongifolium*, Sieb. (1821) non Del., of *Chrozophora hierosolymitana*, Spr. (1826), and of *Chrozophora Sieberi*, Presl (1844). There is no confusion between this plant and *a. verbascifolia;* indeed it is difficult, notwithstanding what has been said and done by later authors, to think of such a confusion as possible. But there was some confusion between β. *hierosolymitana* and γ. *genuina*, to which latter

plant the Spanish and the Greek specimens cited under var. β. belong.

3c. *C. tinctoria* γ. *genuina* (l.c. p. 749) is confined to the 'Tournesol,' as figured by Clusius in 1557 and as described by Linnaeus, under the name *Croton tinctorium*, in 1753. This plant, however, occurs in two states, readily distinguished by the shape of the leaves. The plant from Southern France has these rather rhomboid in outline, as shown in Clusius' figure; many of the specimens from Greece, Crete, Asia Minor and Syria have the leaves ovate and subcordate, as shown in a figure prepared by Gesner about 1561, first published by Camerarius in 1586. This latter state of the 'Toursenol' outwardly much resembles some specimens of var. β. *hierosolymitana*, to which, notwithstanding differences in the flower, Müller has referred it.

3d. *C. tinctoria* δ. *subplicata* (l.c. p. 749), is a form which agrees with var. γ. *genuina* in all its characters save that it is of a prostrate in place of an erect habit.

4. *C. obliqua* (l.c. p. 749) is in intention *Croton oblongifolium*, Del. (1812), which is, as Müller has stated, identical with *Croton tinctorium*? Forsk. (1775) from Arabia, as opposed to the *Croton tinctorium*? Forsk. (*Cent.* vi. p. 162) from Gizeh in Egypt. But it is not, as Müller was led to believe, the Egyptian plant which is *Croton argenteum*, Forsk. (1775) non Linn., whereon was based *Croton obliquum*, Vahl (1790); that plant is identical with *Croton verbascifolium*, Willd. (1805). There are, however, other inadvertences in Müller's account of this species. The Arabian locality of Forskål's specimen which belongs here was not the Sinai Peninsula, but Lohaja in Yemen. The example of this plant which Müller understood to have come from Mayotte in the Comoros was collected by Boivin at Berbera in Somaliland. The Indian plant quoted under *C. obliqua*, Müll.-arg. (1866) non A. Juss., is his own var. β. *hierosolymitana*.

5. *C. Brocchiana* (l.c. p. 750) is treated as it was by Schweinfurth in 1862, but with the inclusion of Schweinfurth's suggested third variety from Senegal under the Nubian var. *Hartmanni*, Schweinf. By some inadvertence Müller has cited an additional locality for the species as 'ad promont. viride (Barter n. 821 in lib. Hook.).' The sheet in question contains two specimens. One of these, which is 'Barter, 812,' not 'Barter, 821,' was collected near Fakum in Borgou; the other, which was collected 'ad promont. Viride, inter Kän et Wochan,' bears the indication 'Brunner 108.' These specimens agree with that on which Lamarck in 1786 based his description of *Croton senegalense*, which Baillon in 1858 included in *Chrozophora senegalense* but in 1860 transferred to *C. plicata*.

6. *C. senegalensis* (l.c. p. 750) includes *Croton senegalense*, as described by Geiseler in 1807 from a draft prepared by Vahl when the latter examined the Jussieu herbarium and limited the species to the plant cited but not described by Lamarck in 1786. It also includes the *Chrozophora* collected by Kotschy in Kordofan which Baillon in 1858 likewise included under *Chrozophora senegalensis*.

Since the appearance of Müller's Monograph in 1866 the attention given to *Chrozophora* has been mainly confined to the forms met with in Africa; to a less extent attention has been bestowed on those which occur in India or in the Orient. Nothing new has had to be said or suggested with regard to those forms met with in the Occident.

History of the African Species, 1767–1912.

In 1867 Schweinfurth enumerated four African forms (*Beitr. Fl. Aethiop.* p. 35) as *Chrozophora Brocchiana, obliqua, plicata,* and *tinctoria.* The first three are the forms so distinguished by Schweinfurth in 1862; the fourth, based on specimens from Meda in Aethiopia, is not the 'Tournesol' proper from Lower Egypt, but the condition of *Chrozophora oblongifolia,* A. Juss. assumed when that plant is in its first season of growth.

Later, however (l.c. p. 235), the influence of Schweinfurth's study of Müller's monograph of the previous year became apparent. Schweinfurth accepted Müller's view that *C. obliqua,* Schweinf. (1862) cannot be *C. obliqua,* A. Juss. (1826), which is certainly sound. But he also accepted Müller's decision that *C. obliqua,* Schweinf. (1862) is identical with *C. prostrata,* Dalz. (1861), a ruling that is, at least, open to doubt; and endorsed Müller's identification of *C. oblongifolia,* A. Juss. with *C. obliqua,* A. Juss., a decision which an examination of *Croton argenteum,* Forsk. non Linn., the basis of *Croton obliquum,* Vahl, proves to be without justification.

Still further on in the same treatise (l.c. Aufzähl. p. 262) Schweinfurth supplied a new list which includes six African names. Of these:—

1. *C. Brocchiana,* from Nubia, is the plant figured by Schweinfurth under this name in 1862.

2. *C. obliqua,* from the coasts of Egypt and Nubia, which is *C. obliqua,* Müll.-arg. (1866) and not *C. obliqua,* Schweinf. (1862) of the earlier list (l.c. p. 35).

3. *C. plicata* from Egypt, Nubia, Sennar, and Bahr-el-Abiad, which is still *C. plicata,* Schweinf. (1862) and therefore is *Croton obliquifolium,* Vis. (1836), as contrasted with *Croton plicatum,* Vahl (1790).

4. *C. prostrata,* from Egypt, Nubia, Kordofan, Sennar, and Abyssinia, which although supposed to be *C. prostrata,* Dalz. (1861) is not that Indian plant, but is the African portion of *C. plicata* γ. *prostrata,* Müll.-arg. (1866) and therefore at the same time is *C. obliqua,* Schweinf. (1862), non A. Juss. (1826) nec Müll.-arg (1866). It is the true *C. plicata,* A. Juss. (1826), because it is the plant described by Vahl in 1790 as *Croton plicatum.*

5. *C. senegalensis,* from Kordofan, is the plant collected by Kotschy at Abu Gerad (*Kotschy* n. 25) which Baillon in 1858 had included in *C. senegalensis,* A. Juss., notwithstanding the fact that in this plant the homomorphic leaves are permanently pubescent and pale green above, whereas in *Croton senegalense,* as cited by Lamarck in 1786 and described by Vahl in Geiseler's

monograph of 1807, the dimorphic leaves are dark green and glabrous above.

6. *C. tinctoria*, from Egypt, Nubia, and Abyssinia, includes two distinct species. The Egyptian plant is the 'Tournesol' itself, *Chrozophora tinctoria*, A. Juss. (1824). That from the coasts of Nubia and Abyssinia is not the 'Tournesol' with red-purple ripe capsules, but the condition assumed in its first year by the species with blue-purple ripe capsules, which is *C. oblongifolia*, A. Juss., but which Schweinfurth, copying from Müller, had been misled into believing ought to bear the name *C. obliqua*.

The account of the genus by Boissier in 1879 (*Fl. Orient.* iv.) includes two forms which are characteristic only of that part of the Orient which lies within the African continent, viz.:—*Chrozophora plicata* and *C. tinctoria* δ. *subplicata*, though all save one of the other Oriental species also occur in Africa. The interest which attaches to Boissier's treatment of *C. plicata* lies in the fact that this species is held, both by the references and the specimens cited, to include *Croton plicatum*, Vahl (1790) and *Croton oblongifolium*, Vis. (1836). These two plants, considered by Boissier to be indistinguishable, were regarded by Schweinfurth in 1862 as separable species and by Müller in 1866 as separable varieties. Schweinfurth, in 1867, while accepting Müller's views as regards the names the two should bear, did not adopt Müller's decision that they should be regarded as conspecific.

The interest which attaches to Boissier's treatment of *C. tinctoria* δ. *subplicata* lies in his suggestion that this form may be a natural hybrid between *C. tinctoria* and *C. plicata*. It has to be said, in favour of this view, that *C. subplicata* is confined to the small area within which the regions occupied by *C. tinctoria* and *C. plicata* overlap. But apart from the circumstance that *C. subplicata* has the prostrate habit characteristic of *C. plicata* there is nothing to justify the suggestion. In every other feature *C. subplicata* is identical with *C. tinctoria* proper. Boissier, it should further be pointed out, apparently misunderstood the essential characters of Müller's proposed variety. Boissier had observed, what it is impossible to overlook, that Schweinfurth had given the name *C. tinctoria* to certain specimens from the Egyptian coast which are different from the true 'Tournesol' of the Mediterranean region. But Boissier did not discover that the specimens in question represent the condition assumed in its first season by the plant which Müller had regarded as *C. obliqua;* he therefore disposed of them, notwithstanding the fact that they are not prostrate in habit, by including them in *C. tinctoria* δ. *subplicata*.

In 1837 Ascherson and Schweinfurth dealt once more with the Egyptian forms (*Ill. Fl. Égypt.* p. 138). Here these authors have definitely accepted the view that *Croton plicatum*, Vahl (1790) and *Croton obliquifolium*, Vis. (1836), easily distinguished though they be, are no more than separate varieties of *Chrozophora plicata*, A. Juss. (1826), a view which Schweinfurth once more endorsed in 1899 (*Bull. Herb. Boiss.* vii. App. 2, p. 306). Ascherson and Schweinfurth in 1887 (l.c.) also for the first time recorded *C. tinctoria*, var. *hierosolymitana*, Müll.-arg., as an Egyptian plant.

In 1888 Balfour dealt with the forms of *Chrozophora* from Socotra (*Trans. Roy. Soc. Edin.* xxxi. p. 277) and enumerated three:—*Chrozophora tinctoria*, which is the condition during its first season of *C. oblongifolia*, A. Juss. (1826) and therefore is *C. tinctoria*, Schweinf. (1867) non A. Juss.; *C. obliqua*, which is normal *C. oblongifolia*, A. Juss. (1826) and therefore is *C. obliqua*, Müll.-arg. (1866) non A. Juss; lastly *C. obliqua* var. *frutescens*, Schweinf., which is based on specimens of *C. oblongifolia*, A. Juss., from a plant older and more woody than usual. The species to which all three Socotra forms belong is rather variable in habit and appearance, a fact which is emphasised by the circumstance that in 1899 Schweinfurth (*Bull. Herb. Boiss.* vii. App. 2, p. 306) proposed the recognition of two more varieties, *angustifolia* and *incisa*, neither of which represents more than a condition of the type.

In 1906 Broun enumerated four forms of *Chrozophora* from the Sudan (*Cat. Sud. Fl. Pl.* p. 72). These are *C. obliqua* from the Red Sea coast at Suakin which is *C. obliqua*, Müll.-arg. (1866) non A. Juss. and therefore is *C. oblongifolia; C. Brocchiana* from Dongola, Khartum, Sennar and Kordofan, supposed to be the species of Visiani as understood by Schweinfurth in 1862: *C. senegalensis*, based on the plant collected by Kotschy at Abu Gerad in Kordofan, an identification accepted from Müller's monograph of 1866; lastly *C. plicata*, the plant common "on river-banks and in depressions on cotton-soil in most parts of the Sudan," which was the basis in 1790 of *Croton plicatum*, Vahl.

In 1912 an official account of the tropical African forms was published by Kew (*Fl. Trop. Afr.* vi. 1). In this account four species were recognised, viz.:—

1. *Chrozophora plicata*, A. Juss. (1826), delimited as it was in 1887 by Ascherson and Schweinfurth with the subdivision adopted by those authors into two varieties; one corresponding with *Croton plicatum*, Vahl (1790), the other corresponding with *Croton obliquifolium*, Vis. (1836) which is also *Chrozophora obliquifolia*, Baill. (1858).

2. *C. oblongifolia*, A. Juss. (1826), under the name which it had borne without question until in 1866 Müller inadvertently misidentified the species with *Croton obliquum*, Vahl (1790).

3. *C. senegalensis*, A. Juss. (1826), as the equivalent of *Croton senegalense* as cited by Lamarck in 1786 but as described by Vahl, through the agency of Geiseler, in 1807; with at the same time a variety *lanigera*, based upon the plant described as *Croton senegalense* by Lamarck in 1786 but not cited by that author.

4. *C. Brocchiana*, Vis. (1836), also with two varieties, one of which is that figured by Schweinfurth as var. *Hartmanni* in 1862, a form for which Ehrenberg had proposed the name *Croton macrocalyx*.

History of the Indian Species, 1869-1906.

In 1869 Stewart alluded to the species of *Chrozophora* of the Panjab (*Punjab Pl.* p. 192). The influence of Müller's monograph on his treatment is evident. Stewart recognised only two

species, *C. plicata* and *C. tinctoria*. The former is *C. plicata*, Müll.-arg. (1866) in the wide sense in which all the forms with stellate-pubescent but not lepidote capsules are regarded as conspecific; it therefore includes the erect form with long racemes and purple capsules as well as the prostrate forms with condensed racemes and non-tinctorial fruits. The latter, however, is treated more critically, because Stewart has explained that the plant intended is not any of the four varieties of *C. tinctoria* segregated by Müller, but is the Indian plant issued by Wallich which Müller referred to *C. obliqua*. It is further noticeable that Stewart, by citing this as *C. oblongifolia*, indicated that he had already appreciated the fact that Müller's identification of *C. oblongifolia* with *Croton obliquum*, Vahl, could not be accepted. In 1870 King (*Pl. N. W. Prov.* p. 15) accepted Stewart's treatment. So, too, did Aitchison with regard to the species with lepidote capsules which he identified with *C. tinctoria* in 1880 (*Trans. Linn. Soc. Bot.* n.s. iii. p. 108) and again in 1881 (*Journ. Linn. Soc.* xix. p. 186). The *C. tinctoria* of all three authors is not, however, the true 'Tournesol' of Europe but is *C. hierosclymitana*, Spr. (1826).

In 1887 Hooker supplied a critical account of the Indian species (*Fl. Brit. Ind.* v.) in which he has added a third species, *C. obliqua*, to the two recognised by Stewart and King.

1. *Chrozophora tinctoria*, Hook. f. (l.c. p. 408), though mainly the species with lepidote capsules so named by Stewart in 1869 is made to include certain specimens from Western India remarkably like Stewart's plant as regards foliage but with stellate-pubescent capsules, which agree with the figure of *Croton tinctorium*, Burm. f. (1768) non Linn., based on a plant raised in Java from seed collected at Surat.

2. *C. obliqua*, Hook. f. (l.c. p. 409), is in intention *C. obliqua*, Müll.-arg. (1866), non A. Juss., and in practice includes specimens of the true *Croton oblongifolium*, Del. obtained in Scinde. But the Panjab and Kashmir specimens referred to *C. obliqua* agree, not with Delile's plant, but with the Indian plant issued by Wallich as 7716 G, which Müller had added to his *C. obliqua;* this Panjab plant is *C. hierosolymitana*, Spr.

3. *C. plicata*, Hook. f. (l.c. p. 409) is *C. plicata*, Stewart (1869) and thus includes all the Indian forms of *Chrozophora* with stellate-pubescent capsules except the one included under *C. tinctoria*. But with unerring judgment Hooker has subdivided this comprehensive 'species' into three very distinct forms which correspond respectively with (*a*) *Chrozophora Rottleri*, Thwaites, and therefore with *C. Rottleri*, A. Juss. (1826); (*b*) an unnamed form which is exactly equivalent to *C. parvifolia*, Klotzsch (1862); (*c*) *Chrozophora prostrata*, Dalz. (1861).

In 1906 Cooke supplied yet another critical revision of the forms from Western India (*Fl. Pres. Bomb.* ii.) in which the number of species is now increased to four; *C. tinctoria*, *C. obliqua*, *C. plicata* and *C. prostrata*.

1. *C. tinctoria*, Cooke, is described as having the capsules both stellate-pubescent and lepidote, which is not the case in any

species of *Chrozophora*. No *Chrozophora* with lepidote capsules has ever been met with in the presidency of Bombay to the south of Scinde. The specimens cited by Cooke all have stellate-pubescent capsules. Therefore *C. tinctoria*, Cooke (1906), non A. Juss., is precisely equivalent to *Croton tinctorium*, Burm. f. (1768), non Linn.

2. *C. obliqua*, Cooke, is exactly equivalent to *C. obliqua*, Müll.-arg. (1866), non A. Juss., and therefore is in reality *C. oblongifolia*, A. Juss. (1826).

3. *C. plicata*, Cooke, is exactly equivalent to *Croton plicatum*, Roxb. (1814), non Vahl, and therefore is in reality *C. Rottleri*, A. Juss. (1826).

4. *C. prostrata*, Cooke, is in intention equivalent to *C. prostrata*, Dalz. (1861). In practice, however, it also includes *C. parvifolia*, Klotzsch (1862), and that the limitation of the species was still further misunderstood we know from the circumstance that Cooke has included, by citation, under Dalzell's species, the African *C. plicata*, A. Juss. (1826) which is *Croton plicatum*, Vahl (1790).

History of the Oriental Species, 1879-1915.

When in 1879 Boissier described the species of *Chrozophora* from the Orient (*Fl. Orient* iv.) he dealt with six different forms: —*Chrozophora plicata, C. gracilis, C. tinctoria, C. tinctoria* var. *subplicata, C. verbascifolia, C. obliqua.*

1. *C. plicata*, Boissier's specimens of which came from the African part of his area, has already been discussed. The citations under this African species of *C. Rottleri*, A. Juss. (1826) and *C. prostrata*, Dalz. (1861), neither of which occurs in the 'Orient,' suggest that the species was not fully understood.

2. *C. gracilis*, from Central Asia, is the plant so named by Fischer and Meyer in 1839 and described under their name by Ledebour in 1850. But this species is identical with *C. sabulosa*, named and described by Karelin and Kirilow in 1842 and described again under their name by Ledebour in 1850 and by Müller in 1886. Müller thus used the name with which a description was first associated, Boissier used the name which was first applied, without description, to this plant.

3. *C. tinctoria*, by the specimens cited, includes besides those that are referable to *Croton tinctorium*, Linn. (1753) some that are really referable to *Chrozophora hierosolymitana*, Spr. (1826).

3*b*. *C. tinctoria* var. *subplicata*, which is confined to Lower Egypt, has already been discussed.

4. *C. verbascifolia* is no longer the natural species named *Croton verbascifolium* by Willdenow in 1805 but is intended to be a fusion of Willdenow's species with *C. hierosolymitana*, Spr. (1826). The proposed union was imperfectly carried out: in practice, *C. hierosolymitana* was partly referred to *C. tinctoria*.

5. *C. obliqua*, as delimited by Boissier, was meant to be *C. obliqua*, Müll.-arg. and therefore to be identical with *Croton oblongifolium*, Del. (1812). In practice, however, *C. obliqua*,

Boiss. was made to include specimens from Wadi Dachel in the Libyan waste, written up by Ascherson as *C. obliqua*, which really belong to the Egyptian species described by Vahl in 1790 as *Croton obliquum*.

From the European portion of Boissier's Orient region Heldreich in 1899 reported a new form, *Chrozophora tinctoria* var. *glabrata* (*Parnassos* p. 277). This form, discovered in Santorin by Sartori, which Heldreich did not describe, proves on closer study to be one of the most interesting in the genus.

In 1915 an instance was afforded of the difficulty experienced in correcting an inadvertence which has become incorporated in an authoritative work. In a careful account of the vegetation of Aden, Blatter (*Rec. Bot. Surv. Ind.* vii. p. 332) has taken up from Müller not only the erroneous reference to an Indian plant issued by Wallich (*Cat. Lith.* 7716 G) but also the erroneous name *Chrozophora obliqua*, Müll.-arg. (1866), non A. Juss. The adoption of Müller's name is in this instance the more remarkable when regard is had to the circumstance that the plant had its true name restored by Pax and Hoffmann in 1912, and that a previous account of the same Flora, published by Anderson in 1860, also used the true name, *C. oblongifolia*, A. Juss.

The Species in Engler's Pflanzenreich.

The treatment of the genus in the 'Pflanzenreich' in 1912 has already been explained. The species recognised are nine in number; one of the nine it has, however, been suggested may be of hybrid origin.

1. *Chrozophora Rottleri* (*Pflanzenr.* IV. 147. vi. p. 19), is *C. plicata* **a.** *Rottleri*, Müll.-arg. (1866) with all the merits and all the defects of the 'Prodromus' account of the variety and with in addition the inadvertent statement that the capsules are not tinctorial.

2. *C. plicata* (l.c. p. 19), is a combination of *C. plicata*, β. *genuina*, Müll.-arg. (1866) and γ. *prostrata*, Müll.-arg. (1866), again with all the defects of the 'Prodromus' account and most of those in the account of Boissier, from whom has been adopted the suggestion of merging three distinct species in one. The statement that this 'species' is not tinctorial is partly true since the two Indian species, *C. prostrata*, Dalz. (1861) and *C. parvifolia*, Klotzsch (1862), are not tinctorial. This statement, however, is not applicable to the original *C. plicata*, A. Juss. (1826).

3. *C. Brocchiana* (l.c. p. 20) is taken up from the 'Prodromus' with no change beyond that of suppressing Schweinfurth's variety *Hartmannii*.

4. *C. senegalensis* (l.c. p. 20) is taken up without change from the 'Prodromus.'

5. *C. tinctoria* (l.c. p. 22) is *C. tinctoria* γ. *genuina*, Müll.-arg. (1866). The belief as to the poisonous qualities of this plant is derived from Kobert (*Lehrb. Intox.* ii. p. 653) whose state-

ment, published in 1906, is due to a misreading of the original record of an incident which occurred in Persia (*Kew Bulletin*, 1889 p. 279), and to Kobert having overlooked the sequel to that record (*Kew Bulletin*, 1896, p. 233). The specimens sent from Persia as ' Tatuleh ' did in reality belong to *C. tinctoria*, Stewart (1869) non Linn., which is identical with *C. hierosolymitana*, Spr. (1826), but it eventually became known that it probably was the true ' Tatuleh ', *Datura Tatula*, Willd., specimens of which were not sent, which actually caused the six deaths.

5a. *C. subplicata* (l.c. p. 24) is *C. tinctoria* δ. *subplicata*, Müll.-arg. (1866), advanced in status. The suggestion as to the parentage of this supposed hybrid is taken up from Boissier, not from Schweinfurth, who notwithstanding the fact that *C. subplicata* has lepidote capsules, has treated it, in the manuscript note to which Pax and Hoffmann refer, as a hybrid between *Croton plicatum*, Vahl, and *Croton obliquifolium*, Vis. (1836), both of which have stellate-pubescent capsules and are, as Schweinfurth subsequently admitted, only varities of a single species. The reference of specimens of the erect *C. oblongifolia* from Kosseir to the prostrate *C. plicata*, is copied from Boissier's account of 1879. The erect Afghan plant, also referred in the ' Pflanzenreich ' to the prostrate *C. plicata*, is *C. hierosolymitana*, Spr. (1826), with a larger number of stamens than usual.

6 *C. glabrata* (l.c. p. 24) is, as Pax and Hoffman have stated, the most easily recognised of all the forms in the genus *Chrozophora*. It is not, however, the most distinct. In their remarks on the phylogeny of this form Pax and Hoffmann have regarded it as a derivative of *C. tinctoria* (l.c. p. 18) but in their notes under the description of the plant they have said that it is extremely distinct from *C. tinctoria* and is more closely related to *C. verbascifolia*, though still distinguishable at a glance from the latter species. Of these two views the former appears to have been adopted from Heldreich who, when he first obtained specimens, named it *C. tinctoria*, var. *glabrata* (*Parnassos* p. 277). The second view is undoubtedly the more satisfactory. Yet, notwithstanding the very different facies of the plant, due to the almost complete absence of the characteristic loose woolly tomentum, a careful examination of the original type leads to the impression that this plant is no more than a nearly glabrous sport or condition of *C. obliqua*, A. Juss., hardly deserving to rank as a distinct variety.

7. *C. oblongfolia* (l.c. p. 24) is *Croton oblongifolium*, Del. (1812) with the erroneous identification suggested by Müller in 1866 corrected, though with still a loophole left for debate owing to the citation under this species of *Croton argenteum*, Forsk. (1775), non Linn., the type of which is also the type of *Croton obliquum*, Vahl (1790). As a matter of fact *Croton argenteum*, Forsk. is not the same as *Croton oblongifolium*, Del. but is identical with *Croton verbascifolium*, Willd. (1805). The ' Prodromus ' error of citing an Indian plant issued by Wallich under this species has been perpetrated in the ' Pflanzenreich ' and a new inadvertence has been introduced by the reference to *C. ob-*

longfolia of a specimen of *C. hierosolymitana* collected by Schlagintweit at Rawalpindi in the Punjab.

8. *C. verbascifolia* (l.c. p. 26) is taken up from Boissier's account of 1879, and thus includes *C. tinctoria* **a.** *verbascifolia*, Müll.-arg. (1866) and β. *hierosolymitana*, Müll.-arg. (1866) two forms which only Baillon, Boissier and the authors of the 'Pflanzenzeich' monograph have united. Many authors have found it difficult to distinguish *C. hierosolymitana* from *C. tinctoria*, when care has not been taken to examine their flowers. But the tendency to confuse *C. hierosolymitana* with *C. verbascifolia* has hardly been greater than the complementary tendency to confuse *C. verbascifolia* with *C. tinctoria*, of which the literature of the genus offers no example. The dubiety suggested as to the identity of *Croton obliquum*, Vahl (1790) does not really exist, for the type of Vahl's species is also the type of *Croton argenteum*, Forsk. (1775) non Linn., and *Croton argenteum*, Forsk., as the specimen in the Copenhagen herbarium shows, is the species which Willdenow in 1805 described as *Croton verbascifolium*.

9. *C. sabulosa* (l.c. p. 27) is taken up from the 'Prodromus.'

Systematic Synopsis.

The results of the foregoing review of the material available and of the conclusions reached by those who have hitherto dealt with this genus are collected in the subjoined synopsis which may, it is hoped, serve the double purpose of facilitating comparison with previous accounts and of indicating the geographical distribution of the various recognisable forms.

CHROZOPHORA Neck.

§ I. Trichocarpa. Capsula pilis stellatis induta, nunquam lepidota.

¶ 1. Plicata, *Pax et K. Hoffm. in Engl. Pflanzenr.* IV. **147**, vi. p. 19, *pro sectione* (1912). Antherae 3-verticillatae quam pars libera filamentorum parum longiores.—*Chrozophora*, § 1, Müll.-arg. in DC. Prodr. xv. 2. p. 747 (1866).

Six species have from time to time been recognised among the members of this group:—1. *Chrozophora plicata*, A. Juss. (1826), which is *Croton plicatum*, Vahl (1790), based on *Croton tinctorium*, Forsk. *Cent.* vi. p. 162 (1775) non Linn.; 2. *Chrozophora Rottleri*, A. Juss. (1826), which is *Croton Rottleri*, Geis. (1807); 3. *Chrozophora Burmanni*, Spr. (1826), based on *Croton hastatum* β. Burm. f. (1768) non *C. hastatum*, Linn.; 4. *Chrozophora obliquifolia*, Baill. (1858), which is *Croton obliquifolium*, Vis. (1836); 5. *Chrozophora prostrata*, Dalz. (1861), which is *Croton plicatum*, Ham. ex Wall. (1830) nec alior.; and 6. *Chrozophora porvifolia*, Klotzsch (1862), based on *Croton plicatum*, Willd. (1805) nec Vahl. We now know, however that 2. *C. Rottleri* and 3. *C. Burmanni* are only conditions of the same species, and that 4. *C. obliquifolia* is only a variety of 1. *C. plicata*.

CLAVIS SPECIERUM INTER 'PLICATAS.'

Capsulae cinereo-nigrescentes; stigmata aurantiaca; petala lutea; caules prostrati:—
  Folia basi eglandulosa, pilis stellatis saepe stipitatis induta; herbacea.. 1. *C. prostrata.*
  Folia basi 2-glandulosa, pilis stellatis sessilibus induta; suffruticosa ... 2. *C. parvifolia.*
Capsulae purpurascentes; stigmata rubra; folia basi 2-glandulosa:—
  Racemi quam folia eis proxima breviores; capsulae violaceo-purpureae; petala punicea:—
    Caules prostrati:—
      Folia undulata; pedunculi brevissimi, basi saepe foliati ... 3. *C. plicata.*
      Folia repanda; pedunculi distincti, nudi ... ... 3*b*. „ var. *obliquifolia.*
    Caules erecti ... ... 3*c*. „ var. *erecta.*
  Racemi quam folia eis proxima longiores; capsulae rubro-purpureae; petala sordide lutea; folia saepe majora; caules erecti ... 4. *C. Rottleri.*

1. **Chrozophora prostrata,** *Dalz.* in Dalz. et Gibs. Bomb. Fl. p. 233 (1861). Annua, prostrata; folia radicalia rosulata, subpersistentia, basi eglandulosa, pilis stellatis magis minusve stipitatis obtecta; petala lutea; stigmata aurantiaca; capsula matura cinereo-nigrescens, haud tinctoria.—Cooke Flor. Pres. Bomb. ii. p. 607 (1906) spec. Afr. cit. exclud. *Croton plicatum*, Ham. ex Wall. Cat. Lith. n. 7716 C et n. 7716 D partim (1830) nec Vahl. *Croton tinctorium*, Wall. Cat. Lith. n. 7716 B. partim (1830) nec Linn. *Croton lanuginosum*, Schum. ex Schweinf. Pl. quaed. Nilot. p. 10 (1862) nec Baill. *Chrozophora plicata* β. *genuina*, Müll.-arg. in DC. Prodr. xv. 2, p. 747 (1866) quoad spec. Ind. cit. sed syn. omn. exclud. *C. plicata* γ. *prostrata*, Müll.-arg. l.c. (1866) quoad syn. Dalz. et Klotzsch tantum. *C. plicata*, 3, Hook f. Fl. Brit. Ind. v. p. 440 (1887). *C. plicata* a, Watt, Dict. Econ. Prod. Ind. ii. p. 260 (1889). *C. plicata* Stewart, Panjab. Pl. p. 192, partim (1869); King, Pl. N.W. Prov. p. 15, partim (1870); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147, vi. p. 19, partim (1912) nec A. Juss.

This species is widely distributed in Peninsular India from the Panjab and the Upper Gangetic Plain southward to Coromandel. In the north-east it does not extend to the Lower Gangetic Plain, in the south-west it does not extend to Malabar. It is a small procumbent annual found in damp situations such as the banks of rivers, the bottoms of dried up tanks, and irrigated fields after the water has been drained off. Its yellow petals, orange stigmas, grey-black non-tinctorial capsules and eglandular leaves distinguish it at once from the allied African forms with which it has hitherto been customary to associate it. In the

African plants in question the leaves are 2-glandular at the base, the capsules are violet-purple and yield a dye, the stigmas are red and the petals, so far as is known, are always pink.

Northern India. Panjab: Jalapur, *Vicary* (*Croton stelligerum*, Vicary MSS.)! Lahore, *T. Thomson*! Multan; *Royle*! *Edgeworth*, 8028! Upper Gangetic Plain: Gorakhpur, *Duthie*, 2249a! Behar; Patna, *Hamilton*, 2107 (*Wall. Cat.* n. 7716 C partim)! Naoranga, near the River Son, *Jacquemont*, 112! 200!

Western India. Gujarat: Rajkot, *Birdwood*! Concan: Northern district, *Ritchie*! Deccan: Aurangabad, *Ralph*, 22! Egadon and Vouanagram, *Campbell*! Kolapur, *Ritchie*, 1345! North Canara; Bomanhulli, *Talbot*, 270! 359! without precise locality, *Stocks*!

Central India. Malwa: Guna, *King*, 34! without precise locality, *Jerdon*! Central Provinces: Nimar; Khandwa, *Duthie*, 8421! without precise locality, *R. Thompson*, 230!

Southern India. Mysore: near Mysore, *Heyne* (*Herb. Rottler*, also *Wall. Cat.* n. 7716 B partim)! Carnatic: Pierwandi, *Wight*, 63 (*Wall. Cat.* n. 7716 D partim)! Kistna; Kaduva Kadkura, *Gamble*, 12562! Chingalpat; Vellapura Choultri, *Griffith*! Madras, *G. Thomson*, 110! Salem; Shevaroi Hills, *Perrottet*, 404! Pondicheri, *Lecomte*! *Raymond*! Tranquebar, *Koenig*! *Rottler*!

2. **Chrozophora parvifolia,** *Klotzsch* ex Schweinf. Pl. quaed. Nilot. p. 10 (1862). Perennis, prostrata; folia radicalia mox evanida basi insigniter 2-glandulosa, pilis stellatis sessilibus parce obtecta; petala lutea; stigmata aurantica; capsula matura cinereo-nigrescens, haud tinctoria.—*Croton plicatum*, Willd. Sp. Pl. iv. 1, p. 538 (1805), quoad spec. Ind. cit. sed syn. omn. exclud.; Klein ex Schweinf. Pl. quaed. Nilot. p. 10 (1862): nec Vahl. *Chrozophora plicata* γ. *prostrata*, Müll.-arg. in DC. Prodr. xv. 2, p. 747 partim (1866) quoad syn. Klein et Klotzsch tantum. *Chrozophora plicata* 2, Hook. f. Fl. Brit. Ind. v. p. 410 (1887).

This species, like the preceding, to which it is nearly allied, is confined to Peninsular India, where it is widely spread from Scinde, the Panjab, and the Upper Gangetic Plain southward to Coromandel, but while present in Scinde, whence *C. prostrata* has not so far been reported, it has never been gathered in the Deccan or in any part of Central India except Bundelkhand. A procumbent plant like the preceding species, it has in almost every instance been gathered as a woody plant of more than one season's growth on dry, rocky hillsides or in arid fields.

In their excellent monograph of the genus *Chrozophora*, Pax and Hoffman have suggested (*Pflanzenr.* IV. 147, vi. p. 17) the possibility of the occurrence within it of natural hybrids. The case of *C. parvifolia* is one that seems to bear out their view; it might be regarded as a natural cross between *C. Rottleri* and *C. prostrata*, in which the glands at the base of leaf beneath and the tomentum of the former are combined with the prostrate habit and the non-tinctorial capsules of the latter. Though *C. prostrata* does not appear to persist for a second season and *C. Rottleri* never

does so in Northern India, the latter species seems to do so in Southern India. The chief difficulty connected with the acceptance of the view lies in the fact that *C. parvifolia* occurs in Scinde, where *C. prostrata* has not yet been found.

Northern India. Scinde: without precise locality, *Stocks* 547! Punjab: Lahore, *T. Thomson*, 1508! Ambala, *Edgeworth*, 126! Sirsa, *Drummond*, 2352! near Tusham Rock, *Herb. Drummond*, 3060! 3062! Khanak Hill, 1000 ft., *Herb. Drummond*, 3061! Hissar, *Ram Baksh in Herb. Drummond*, 6346! Gurgaon, *Ram Baksh in Herb. Drummond*, 6345! Karnal, *Drummond*, 6348! Upper Gangetic Plain: Oudh; Kheri, *Duthie*, 22494! Lucknow, *Anderson*! Farukhabad; Fatehgarh, *Griffith*! Mirzapur; near Mirzapur, *Griffith*! without precise locality, *Royle*!

Central India. Bundelkhand: without precise locality, *Edgeworth*, 8029!

Southern India. Madras Presidency: Anantapur; Bukkapatam, 1500 ft., *Gamble*, 21167! Chingalpat; Tiruvalur, *Klein* 396 *in Herb. Willdenow*! near Madras, *Griffith*! Salem; Shevaroi Hills, *Perrottet*, 77!

In the Edinburgh Herbarium there is an Indian specimen of *Chrozophora parvifolia*, collected by Ritchie, which has not been localised. The question as to the possible provenance of this specimen (*Ritchie* n. 670) will be discussed along with the similar problem involved in the case of another (*Ritchie* n. 671) which belongs to *Chrozophora hierosolymitana*, and is also unlocalised. It may be stated here, however, that probably neither specimen came from any part of the Bombay Presidency, which was the scene of Ritchie's activities as a collector.

The locality Malacca, cited by Müller, is the result of some misapprehension; the specimen, which was collected by Klein, came from Southern India.

3. **Chrozophora plicata,** *A. Juss.* ex Spr. Syst. Veg. iii. p. 850 (1826) syn. Lamk exclud. Annua, saepissime prostrata raro in Africa orientali erecta; folia radicalia mox evanida, caulina basi 2-glandulosa, pilis stellatis magis minusve stipitatis obtecta; petala pallide punicea; stigmata rubra; capsula matura violaceo-purpurea, distincte tinctoria; racemi congesti quam folia summa breviores.—Prain in Dyer, Fl. Trop. Afr. vi. i., p. 834 (1912).

This species is very characteristically African; the statement made by Vahl, Willdenow, and Geiseler that it occurs in Arabia is due to an inadvertence on the part of the first-named author. The statement that it occurs in India, which originated with Willdenow and has been adopted by many subsequent writers, is due to misidentification, now with one, now with another, at times with both of the prostrate Indian species belonging to this section. The only records of the species from outside Africa are one, which is doubtful, from Syria, and another, which is authentic, from Palestine, where the plant is evidently very rare and where it may owe its presence to introduction as a weed of cultivation.

In Africa it is widely spread and has been recorded from the

catchment-areas of the Senegal River, the Niger-Benue basin, the drainage area of Lake Chad, the Nile basin, and again in the catchment-areas of the Zambesi and the Limpopo. It has not yet been reported from any locality in the Congo basin or in that of the Cunene or the Orange River.

Three very easily distinguishable varieties may be recognised.

a. **typica**, *Pram*, l.c. (1912). Prostrata; folia caulina saepissime longiora quam lata, margine undulata; pedunculi perbreves saepius versus basin foliiferi.—*Croton tinctorium*, Forsk. Fl. Aegypt.-Arab. Cat. Aegypt. n. 490, p. lxxv. et (dubitanter) Cent. vi. p. 162 (1775), nec Linn. *Croton plicatum*, Vahl, Symb. Bot. p. 78 (1790); Willd. Sp. Pl. iv. 1, p. 538 partim (1805) quoad syn. Vahl tantum; Geis. Crot. Monogr. (*plicatus*) p. 70 (1807), syn. Lamk et Burm. f. omnino syn. Vahl pro parte maxima excl.; A. Juss. Tent. Gen. Euph. p. 28 (1824). *Chrozophora plicata*, A. Rich. Tent. Fl. Abyssin. ii. p. 252 (1851) excl. syn. Burm. f.; Baill. Étud. gén. Euphorb. p. 322 (1858) et in Adansonia i. p. 67, partim (1860); Boiss. Fl. Orient. iv. p. 1140 partim (1879); Engl. Hochgebirgesfl. Trop. Afr. p. 283 partim (1892); Pax in Istit. Bot. Roma, vi. p. 183 (1895); Broun, Cat. Sud. Fl. Pl. p. 72 (1906); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 19 partim (1912). *C. obliqua*, Schweinf. Pl. quaed. Nilot. p. 10, t. 3 (1862), et in Beitr. Fl. Aethiop. p. 35 (1867), non A. Juss. nec Müll.-arg. *C. obliquifolia*, Kotschy ex Schweinf. Pl. quaed. Nilot. p. 10 (1862), vix Baill. *C. plicata*, γ. *obliqua*, Müll.-arg. in DC. Prodr. xv. 2, p. 698 (1866). *C. plicata*, γ. *prostrata*, Müll.-arg. l.c. p. 747 (1866), quoad spec. Afr. cit. tantum; Oliv. in Trans. Linn. Soc. xxix. p. 146 (1875); Aschers. et Schweinf. Ill. Fl. Égypt. p. 168 (1887); Schweinf. in Bull. Herb. Boiss. vii. App. 2, p. 306 (1899). *C. prostrata*, Schweinf. Beitr. Fl. Aethiop. pp. 235, 262 (1867), non Dalz.

Senegal River Basin. Senegal: Dagana, *Leprieur*! Podar, *Mathieu*!

Niger-Benue Basin. Cameroon: Garua, on sandbanks in the bed of the River Benue, *Ledermann*, 3239!

Lake Chad Basin. Northern Nigeria: Bornou; Kuka, near Lake Chad, *Vogel*, 32! French Congo: Kusseri, on the River Shari, *Foureau*, 3006!

Nile-land. Sudan: banks of the Nile; at about 16° N. Lat., *Speke & Grant*! Nuer; on the White Nile, *Brownall*! at Geitena, *Schweinfurth*, 898! Sennar: Abu Sugra, *Schweinfurth*! Wolet Medine, *Kotschy*, 473 partly! Kordofan, *Colston*, 52! 63! Salati, *Broun*! on the Blue Nile, *Muriel*, S/37! Abyssinia: Goelleb, 4000 ft., *Schimper*, 27! 1694! Amhara; Jenda, *Steudner*, 533! by the Tacazza River, *Petit*! *Quartin-Dillon & Petit*, 213! without precise locality, *d'Hericourt*! Eritrea: Godofelassi, 6000 ft. *Schweinfurth* (specn. not seen). Nubia: Dongola, *Ehrenberg*! *Rifaud*! Upper Egypt: Karnak, *Courbon*, 438! Thebes, *Bornmüller*, 10949! Lower Egypt: Gizeh, *Forskål*! near Cairo, *Ehrenberg*! *Schweinfurth*, 137! *Wichura*, 3075! *Pfund*! near Shubra Alley, *Schweinfurth*! between Cairo and Romanieh,

Tomard! Zagazig, *Ball*! Benha, *Schweinfurth*, 837! Damietta, *Ehrenberg*! Samit Naïm, *Samaritani*, 3612! Torrah, *Kotschy*! *Boissier*! without precise locality, *Delile*! *Richard*! *Montbret*!

Zambesi River Basin. Rhodesia: common on sandbanks in rivers, *Allen*, 716! on the banks of the Zambesi, *Wilde in Herb. Transvaal*, 9054!

Asia. Syria: Palestine; Jerusalem, *Meyers*, 95 partly! without precise locality, *Olivier & Bruguière*!

β. **obliquifolia,** *Prain*, l.c. p. 835. Prostrata; folia caulina aeque longa ac lata, margine repanda; pedunculi distincti, nudi. —*Croton plicatum*, Sieb. Avis, herb. Aegypt. p. 7; advers. p. 8 (1821), vix Vahl. *Croton obliquifolium*, Vis. Pl. quaed. Aegypt. ac Nub. p. 39, t. 7, fig. 1 (1836). *Chrozophora obliquifolia*, Baill. Étud. gén. Euphorb. p. 322 (1858). *C. plicata*, Baill. in Adansonia i. p. 67, partim (1860); Schweinf. Pl. quaed. Nilot. p. 11, t. 4 (1862), syn. Vahl. excl.; Klotsch in Peters, Reis. Mossamb. Bot. ii. p. 576 (1863); Schweinf. Beitr. Fl. Aethiop. pp. 36, 262 (1867); Boiss. Fl. Orient. iv. p. 1140, partim (1879); Aschers. et Schweinf. Ill. Fl. Égypt. p. 168 (1887); Engl. Hochgebirgesfl. Trop. Afr. p. 283, partim (1892); Pax in Engl. Pfl. Ost-Afr. C. p. 237 (1895); vix A. Juss. *C. tinctoria*, Klotzsch, l.c. p. 99 (1861), non A. Juss. *C. plicata*, β. *genuina*, Müll.-arg. in DC. Prodr. xv. 2, p. 747 (1866), quoad spec. Afr. cit. tantum.

Senegal River Basin. Senegal: Dagana, *Leprieur*!

Lake Chad Basin. Northern Nigeria: Kuka, near Lake Chad, *Vogel*, 3!

Nile-land. Sudan: Burri, *Schweinfurth*, 832! near Shendy, *Schweinfurth*, 737! North Ipsambul, *Scott Elliot*, 3418! Sennar: Fazokl, *Ehrenberg*! near Abu Harrah, *Schweinfurth*, 833! 834! Wolet Medine, *Kotschy*, 473 partly! White Nile, *d'Arnaud*! Kordofan, *Pfund*! *Colston*, 14! Abyssinia: Begemeder; by the River Reb. *Schimper*, 1355! Eritrea: Abai, *Stecker*! Godofelassi, *Rohlfs & Stecker*! Nubia: Dongola, *Ehrenberg*! Daggeh and Sabou, *Kralik*! without precise locality, *Pfund*! Upper Egypt: Assiout, *Sieber*! *Lusson*, 309! *Bromfield*! El Haameh, *Rohlfs*, 2216! Middle Nile, *Wenne*! Dendera, *Hartmann*! Assouan, *Kügler*! Farshut, *Schweinfurth*, 854! Thebes, *Wilkinson*! near Gournass, *Letournoux*, 302! Lower Egypt: Pyramids, *Sieber*! Pilgrims' Lake and Birguet-el-Agio, *Richard*! Cairo, *Heldreich*! *Wiest*! ten miles south of Benha, *Schweinfurth*, 856! Wadi Dugla, beween Cairo and Suez, *Schweinfurth*! Suez, in clover fields, *Rensch in Herb. Hildebrandt*, 89! Torrah, *Kotschy*! without precise locality, *Olivier & Bruguière*! *Aucher*, 2005! *Galopin*! *Boissier*! *Wiest in Herb. Schimper*, 517! *Fischer*!

Zambesi River Basin. Mozambique: Sena, *Peters*, 8! Gononogoza; Sungine, *Vasse*, 403!

γ. **erecta,** *Prain*. Erecta; folia caulina aeque longa ac lata, margine undulata; pedunculi perbreves, nudi.

Limpopo River Basin. Mozambique: Mazambo; eastern bank of the River Limpopo, *Beijer*!

The two first varieties are prostrate branching herbs with a stout root. In the Sudan a blue dye is obtained from the capsules. The stems yield a strong fibre which is not easily separable (*Broun*). Both the seeds and the leaves have purgative properties. All three varieties occur on river banks and on sandbanks in river beds. The two prostrate varieties occur also in depressions, more especially in cotton soil; the second variety is, besides, a common weed of cultivated ground and palm groves.

The specimens of the typical plant collected by Olivier and Bruguière which have been localised as from Syria have no original field-note. The same is the case with the specimens of β. *obliquifolia*, obtained by the same collectors, which have been localised as from Egypt. It is therefore permissible to conjecture that some error has taken place with regard to the Syrian habitat. This conjecture is not, however, necessarily correct because it has recently been ascertained that typical *C. plicata* does occur now, near Jerusalem, perhaps as a recent introduction. In the Limpopo locality, which is close to the Tropic of Capricorn, the species is plentiful, but only the third variety, Dr. Beijer informs us, is to be met with there. The statement relied upon in 1912 that the petals in β. *obliquifolia* may be yellow (*Fl. Trop. Afr.* vi. 1. p. 835) appears to be incorrect; they are pink, as in *a. typica* and in γ. *erecta*. The statement that the plant is not tinctorial (*Pflanzenr.* IV. 147. vi. p. 18), though correct as regards the two Indian species there merged in *C. plicata*, does not apply to any of the forms of *C. plicata* itself.

4. **Chrozophora Rottleri,** *A. Juss.* ex Spr. Syst. Veg. iii. p. 850 (1826). Annua vel raro diutina, erecta; folia omnia caulina, basi 2-glandulosa, saepissime rotundata, margine plerumque plus minusve 3-loba, nonnunquam undulato-crenata, rarius ovata subacuta vel acuta margine subintegra, pilis stellatis sessilibus aspera; petala lutea; stigmata rubra; capsula matura rubro-purpurea, valde tinctoria; racemi pro genere elongati, folia summa aequantes vel excedentes.—Thwaites, Enum. Pl. Zeyl. p. 443 (1864); Pax et K. Hoffm. in Eng. Pflanzenr. IV. 147. vi. p. 19 (1912). *Ricinoides malabarica surattensis*, Garcin ex Burm. f. Fl. Ind. p. 305 [205] (1768). *Croton tinctorium*, Burm. f. l.c. p. 304 [204], t. 62, fig. 1 (1768); Roxb. ex Wall. Cat. Lith, n. 7716 A, B partim, I (1830), nec Linn. *Croton hastatum* β., Burm. f. l.c. 305 [205], t. 63, fig. 1 (1768), non *C. hastatum*, Linn. *Croton tinctorium* β. et γ., Lamk Encyc. Meth. ii. p. 214 (1786). *Croton moluccanum*, Willd. Sp. Pl. iv. 1, p. 551 (1805), non Linn. *Croton Rottleri*, Geis. Crot. Monogr. p. 54 (1807); A. Juss. Tent. Gen. Euph. p. 28 (1824). *Croton asperum*, Koen. ex Roxb. Hort. Beng. p. 104 (1814); Wall. Cat. Lith. n. 7716 C partim, F (1830). *Croton plicatum*, Roxb. Hort. Beng. p. 69 (1814); Ainsl. Mat. Med. ii. p. 398 (1826); Wall. Cat. Lith. n. 7716 D partim, E (1830); Roxb. Fl. Ind. iii. p. 681 (1832); Grah. Cat. Bomb. Pl. p. 182 (1834), non Vahl. *Croton polycarpum*, Wall. Cat. Lith. n. 7716 H (1830). *Chrozophora Burmanni*, Spr. l.c. p. 51 (1826). *Chrozophora plicata*, Voigt, Hort. Suburb. Calc. p. 156 (1846); Dalz. et Gibs. Fl. Bomb. p. 233 (1861);

Stewart, Punjab Pl. p. 192 partim (1869); King, Pl. N.W. Prov. p. 15 partim (1870); Prain, Beng. Pl. p. 994 (1903); Cooke, Fl. Pres. Bomb. ii. p. 607 (1906), non A. Juss. *Chrozophora plicata*, *a. Rottleri*, Müll.-arg. in DC. Prodr. xv. 2, p. 747 (1866). *Chrozophora tinctoria*, Hook. f. Fl. Brit. Ind. v. p. 408 partim (1887) et quoad spec. e Scinde et e Deccan cit. tantum; Cooke, p. 606 (1906), non A. Juss. *Chrozophora plicata* 1, Hook. f. l.c. p. 409 (1887). *Chrozophora plicata*, β., Watt Dict. Econ. Prod. Ind. ii. p. 620 (1889). *Tournesolia plicata*, O. Kuntze, Rev. Gen. Pl. ii. p. 621 (1891).

A distinctively Indian species, very rare in the Punjab, where it is replaced by the non-tinctorial *C. parvifolia*, Klotsch, but common from Scinde and the Upper Gangetic Plain southwards to Coromandel and Northern Ceylon; absent from Malabar and Southern Ceylon. From the Upper Gangetic Plain it extends to the Lower Gangetic Plain, thence into the valleys of the Brahmaputra and the Surma and again thence into those of the Irrawadi in Burma, and of the Meinam in Siam.

Usually an annual-field weed throughout its area and always so in Northern India and Western Indo-China. *Chrozophora Rottleri* sometimes lasts for more than one season in dry waste places and on roadsides in Central and especially in Southern India. When perennial and shrubby the leaves become smaller and less distinctly lobed. At times, more especially in Western India, the leaves in the ordinary annual condition are longer than broad, more or less acute and nearly entire. The various conditions pass insensibly into one another and cannot be satisfactorily separated as varieties. The normal form with rounded, somewhat 3-lobed leaves is that distinguished by Sprengel as *C. Burmanni* (*Croton hastatum* β., Burm. f.; *Croton plicatum*, Roxb. non Vahl; *Croton asperum*, Koen.); the form with narrower subentire somewhat acute leaves is *Chrozophora tinctoria*, Cooke, non A. Juss. (*Croton tinctorium*, Burm. f. non Linn.); the perennial shrubby condition with rather smaller, rounded but not very markedly lobed leaves is that on which Geiseler based his description of *Croton Rottleri*.

The remark by Pax and Hoffman (*Pflanzenr.* IV. 147. vi. p. 18) that *Chrozophora Rottleri* is not tinctorial is not deserved; as Roxburgh has remarked (*Fl. Ind.* iii. p. 681), "cloth moistened with the green capsules soon becomes blue, after exposure to the open air."

Ceylon. Trincomali, *Glenie in Herb. Thwaites*, 3854!

Southern India. Carnatic: Tanjore; Tranquebar, *Koenig*! *Heyne in Herb. Wallich*! *Rottler or Klein in Herb Wallich*! Coimbatore, *Beddome*, 7293! Anamalai, *Wight*, 2313! 2613! Pondicheri, *Commerson*! *Macé*, 759! *Raymond*! *Lamarre-Picquart*! Chingalpat; near Devanur, *Klein*! Haskancharni, *G. Thomson*, 24! Madras, *Shuter*! *Griffith*! *Wight*, 62! Cuddapah: Poramanilla, 500 ft., *Gamble*, 11097! Mysore: Salikraman, *G. Thomson*, 428! Circars: Samalcotta, *Roxburgh*! without precise locality, *Russell in Herb. Wallich*! *Beddome*, 7294!

Western India. Deccan: Dharwar, *Cooke*! Vouanagram,

Campbell! Aurangabad, *Ralph*, 21! Poona, *Stocks*! *Cooke*! *Woodrow*! Concan: North Concan, *Ritchie*! Surat, *Garcin* (Ic. Burm.)! Gujarat: near Gujarat, *Woodrow*! Scinde: near Karachi, *Dalzell*! between Karachi and Tatta, *Schlagintweit*, 10995!

Central India. Malwa: without precise locality, *Jerdon*! Central Provinces: Nimar; Khandwa, *Duthie*, 8422! without precise locality, *R. Thompson*!

Northern India. Panjab: Lahore, *T. Thomson*! Upper Gangetic Plain: near Saharanpur, *Royle*! Gonda; Barhaiwa, *Inayat*! Pilibhit, *Duthie*, 22495! Banda, *Bell*, 85! Mirzapur; banks of the Ganges at Shahganj, *Hooker*, 545! *Griffith*! Behar; Naoranga, *Jacquemont*, 12! 113! Domdoha, *Hamilton*, 2106! Lower Gangetic Plain: Bengal; Maldah, *Vicary*! Kushtia, *Kurz*! Manbhum, *Campbell in Herb. Watt*, 9811! Sonthal Parganahs, *Campbell*! Caragola Ghat, *Kurz*! Chandernagore, *Herb. Calcutta*! Serampore, *Carey*! Sibpur, *Roxburgh*! *Wallich*! *Gaudichaud*! *Griffith*! *T. Anderson*! *Kurz*! 24-Parganahs: Takeo, *Clarke*, 34845! Sundribuns, *Clarke*, 33360! *Jornadun*!

Indo-China. Assam: Surma Valley, *Hooker*, 301! Golaghat, *Jenkins*! *Simons*! Burma: Kyouk-zeik, *Buchanan*! Pegu, *Roxburgh*! Paghanmyo, *Wallich*. 7716 I! Myingyan, *Griffith*! *J. Anderson*! Prome, *McClelland*! Myanoung, *Gamble*, 2828! Tonkyeghat, *Kurz*, 1545! Sagain, *King's Collector*! Kyouske, *King's Collector*! Siam: Radboeri, *Teijsmann*, 2443!

The Java locality, given by Burmann in 1768, depends on a specimen grown in a Batavia Garden from seed brought by Garcin from Surat. The Moluccas locality, quoted by Müller, depends on an inadvertence; the specimen cited came from Southern India, where it was collected by Klein.

¶ 2. Graciles. Antherae 2-verticillatae, quam pars libera filamentorum breviores.—*Chrozophora*, §2, *a.*, Müll.-arg. in DC. Prodr. xv. 2, p. 748 (1866).

At one time two species were recognised in this group:—1. *Chrozophora gracilis*, Fisch. et Mey. (1839) and 2. *Chrozophora sabulosa*, Kar. et Kir. (1842). The former was collected by Karelin in Turkestan, and the species based on his specimens, though duly recognised, was never described. The latter was collected by Karelin and Kirilow in Soongaria, and the circumstance that when Karelin took his share in drafting a description of the new species he did not employ the name already bestowed upon his own Turkestan plant, suggests, at least, that he regarded the two as different. This surmise is more than confirmed by the fact that in 1850 Ledebour described the two as distinct. But the only character given by Ledebour as diagnostic is that in *C. gracilis* the leaves are usually acute, in *C. sabulosa* they are always obtuse. Later specimens collected by Lehmann enabled Bunge in 1851 to decide that the two plants are conspecific. This decision has been adopted by Müller, who in 1866 used the name recognised by Bunge; also by Boissier, who in 1879 used that published without a description in 1839.

Regel and Herder in 1869 followed the recently published work of Müller; Kuntze on the other hand in 1891, when changing the generic name to *Tournesolia*, followed Boissier as regards the specific one. In 1912 Pax and Hoffman have once more adopted for the only species of the group the name *Chrozophora sabulosa* which, though not the oldest, is the one under which a description was first given.

5. **Chrozophora sabulosa,** *Kar. et Kir.* Bull. Soc. Nat. Mosc. xv. p. 446 (1842). Annua, erecta; folia basi eglandulosa, pilis stellatis sessilibus griseo-tomentella; petala lutea; stigmata rubra; capsula matura rubro-purpurea, tinctoria; semina laevia. —Ledeb. Fl. Ross. iii. 2, p. 581 (1850); Bunge, Rel. Lehm. p. 314 (1851); id. in Mém. Acad. Pétersb. vii. p. 490 (1854); Baill. Etud. gén. Euphorb. p. 322 (1858); Müll.-arg. in DC. Prodr. xv. 2, p. 748 (1866); Regel et Herd. Enum. Pl. Semenov. pars 4, p. 94 (1869); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147, vi. p. 27 (1912). *Chrozophora gracilis*, Fisch. et Mey. Bull. Soc. Nat. Mosc. xii. [Kar. Enum. Turc.] p. 171, nomen (1839); Ledeb. l.c. (1850); Boiss. Fl. Orient. iv. p. 1140 (1879). *Tournesolia gracilis*, O. Kuntze, Rev. Gen. ii. p. 621 (1891).

This is a very distinct, rather isolated and somewhat outlying Asiatic species, which extends from Northern Turkestan to Soongaria.

Central Asia. Soongaria: between Sassky Pastau and the Arganiti Mountains, *Karelin & Kirilow*, 1941! on the River Ilu, *Schrenk*, 24! on the River Ili and in the Ili plains, *Semenow*! Turkestan: Kisil-kum; between the River Kuwan and the River Jan-darya, *Lehmann*, 1249! Suidun, *A. Regel*! Askabad, *Litwinow*, 172! *Sintenis*, 416! without precise locality, *Turczaninow*!

§ II. Lepidocarpa. Capsula lepidota nec stellato-pilosa; antherae semper 2-verticillatae quam pars libera filamentorum parum longiores.—*Chrozophora*, § 2, β, Müll.-arg. in DC. Prodr. xv. 2, p. 749 (1866).

¶ 3. Tinctoriae, *Pax et K. Hoffm. in Engl. Pflanzenr.* IV. 147, vi. p. 21 (C. sabulosa *excl.*), *pro sectione* (1912). Petala sordide lutea; stigmata rubra; capsula matura purpurea, tinctoria, squamis discretis margine denticulatis obsita; semina aspera.—*Chrozophora*, § 2, β., i., Müll.-arg. l.c. (1866).

The number of forms admitted in the group *Tinctoriae* has varied somewhat. Tournefort in 1703 recognised two species of *Ricinoides ex qua paratur* Tournesol gallorum, which he distinguished as *folio oblongo et villoso*, and as *folio serrato non villoso* respectively. Willdenow in 1805 nominally distinguished three:—*Croton tinctorium*, Linn. (1753); *C. obliquum*, Vahl (1790); and his own *C. verbascifolium*, based on Tournefort's *Ricinoides . . . . folio oblongo et villoso.* In reality, however, Willdenow only dealt with two species because *C. verbascifolium* is the same as the older *C. obliquum*. Geiseler

in 1807 enumerated the same three species, as *Croton tinctorius*, *C. obliquus* and *C. verbascifolius;* the difference between his treatment and that of Willdenow was that whereas Willdenow had not seen the type of *Croton obliquum*, Vahl, Geiseler, who had that plant before him, did not examine the type of *C. verbascifolium*, Willd. In 1824 the younger Jussieu, although he knew that *C. verbascifolium* and *C. obliquum* are identical, cited both as examples of *Chrozophora*, Neck., along with *C. tinctorium* and *C. oblongifolium*, Del. (1812) so that his four nominally enumerated forms belonging to the group *Tinctoriae* in reality represent only three species.

Since the resuscitation of *Chrozophora* it has been usual to enumerate five forms with characters that mark them as members of this group. In 1826 Sprengel cited the four mentioned by A. Jussieu as *Chrozophora tinctoria*, i.e. *Croton tinctorium*, Linn. (1753); *obliqua*, i.e. *Croton obliquum*, Vahl (1790); *verbascifolia*, i.e. *Croton verbascifolium*, Willd. (1805); and *oblongifolia*, i.e. *Croton oblongifolium*, Del. (1812); but added a fifth, *hierosolymitana*, i.e. *Croton oblongifolium*, Sieb. (1821), non Del. In reality, therefore, Sprengel dealt with only four distinct members of the group *Tinctoriae*. The five enumerated by Baillon in 1858 were:—*Chrozophora integrifolia*, Bunge (1851); *tinctoria*, i.e. *Croton tinctorium; obliqua*, i.e. *Croton obliquum; verbascifolia*, i.e. *Croton verbascifolium;* and *oblongifolia*, i.e. *Croton oblongifolium*. Though the list of Baillon agrees as regards number of species with that provided by Sprengel, the species are not the same. Baillon has not accounted for *Chrozophora hierosolymitana*, and as *C. integrifolia* is merely a new name for the species to which the two names *obliqua* and *verbascifolia* alike belong, we have in his list only three species of the group *Tinctoriae*.

In 1866 Müller only recognised two species, *Chrozophora tinctoria* and *C. obliqua*. As, however, he has, under *C. tinctoria*, Müll.-arg., discriminated four varieties, viz.:—*verbascifolia* (=*Croton verbascifolium*, Willd.); *hierosolymitana* (=*Chrozophora hierosolymitana*, Spr.); *genuina* (=*Croton tinctorium*, Linn.) and a new form *subplicata*, we find again the same number of forms as were distinguished by Sprengel and Baillon. In this instance, however, the treatment has the advantage as compared with that of Sprengel and Baillon that all the forms recognised are legitimate and valid; it has the disadvantage as compared with theirs that *C. obliqua*, Müll.-arg. is identical with *Croton oblongifolium*, Del. (1812) and is therefore quite different from the true *C. obliqua*, A. Juss., which is a homonym of *Croton obliquum*, Vahl. (1790). In 1879 Boissier recognised only four forms:—*Chrozophora tinctoria*, in intention, at least, identical with *Croton tinctorium*, Linn. (1753), but with, under this species, Müller's variety δ. *subplicata* which, Boissier suggested, might be a hybrid. Boissier's third form and second species is, in intention, a fusion of Müller's quite distinct and easily distinguishable forms of *tinctoria*, *α. verbascifolia* and *β. hierosolymitana;* his last form and third species, *C. obliqua*, is not the plant so named by Jussieu, but that so named by Müller. In

1891 O. Kuntze followed Boissier in recognising three species as *Tournesolia obliqua*, *tinctoria* and *verbascifolia*, the last as doubtfully a distinct species.

In 1912 Pax and Hoffmann reverted to the number of forms recognised by Sprengel, Baillon and Müller, the five enumerated by them being (1) *Chrozophora tinctoria*, A. Juss. (*Croton tinctorium*, Linn.); (2) *C. subplicata* Pax et K. Hoffm. (*C. tinctoria* δ. *subplicata*, Müll.-arg.), which they follow Boissier in regarding as a hybrid; (3) *C. verbascifolia*, A. Juss. (*Croton verbascifolium*, Willd.) which they consider, as Jussieu did, to be identical with *Croton obliquum*, Vahl; *C. glabrata*, Pax et K. Hoffm., based on *C. tinctoria*, var. *glabrata*, Heldr. (1899); and *C. oblongifolia*, A. Juss. (*Croton oblongifolium*, Del). This treatment, like that of Müller, has the advantage that all the forms recognised are valid though, perhaps, not all of them are distinct species. It has, however, the disadvantage, as compared with the arrangement of Müller, of following Boissier in merging *C. hierosolymitana* in *C. verbascifolia*. It is true that *C. hierosolymitana* has flowers like those of *C. verbascifolia*. But it is not the case that it is difficult to distinguish between these two forms; the difficulty is rather to distinguish, without careful dissection, between *C. hierosolymitana* and *C. tinctoria*. When we add *C. hierosolymitana*, Spr. to the forms recognised by Pax and Hoffmann we find therefore that in the group *Tinctoriae* we have six forms, belonging to four species, as indicated in the subjoined conspectus.

Clavis specierum inter "Tinctorias."

Capsulae maturae distincte muricatae :—	
Folia quam lata duplo longiora; capsulae maturae violaceo-purpureae; frutex erectus	6. *C. oblongifolia.*
Folia quam lata minopere longiora; capsulae maturae rubro-purpureae; herbae :—	
Antherae 9–11, saepissime 10; folia adulta saepius scabrida, raro molliter tomentosa :—	
Caulis erectus	7. *C. tinctoria.*
Caulis prostratus...	7*b*. ,, var. *subplicata.*
Antherae 5–6, raro 7–8; folia adulta velutina rarius parce tomentosa	8. *C. hierosolymitana.*
Capsulae maturae vix vel minopere muricatae, rubro-purpureae; antherae 4–5, raro 6–7; folia quam lata dimidio longiora :—	
Folia utrinque laxe molliter lanuginosa	9. *C. obliqua.*
Folia utrinque glabrescens vel glabra..	9*b*. ,, var. *glabra.*

6. **Chrozophora oblongifolia,** *A. Juss.* ex Spr. Syst. Veg. iii. p. 850 (1826). Hornotina herbacea, diutina fruticosa, erecta; folia subfloccoso-tomentosa quam lata duplo longiora, margine

saepissime inciso-lobata vel lobata; antherae saepius 4-7; capsula natura distincte muricata, coeruleo-purpurea.—Decaisne in Ann. Hist. Nat. sér. 2, ii. [Flor. Sin.] p. 242 (1834); Baill. Étud. gén. Euphorb. p. 322 (1858); T. And. in Journ. Linn. Soc. v. Suppl. [Flor. Aden.] p. 36 (1860); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 25, loc. Panjab et syn. Forsk. ac Wall. necnon syn. *C. obliqua*, A. Juss. excl. (1912); Prain in Dyer Fl. Trop. Afr. vi. 1, p. 836 (1912). *Croton tinctorium*? Forsk. Fl. Aegypt.-arab. n. 563 Cat. Arab.-Yem. p. cxxi. (1775), nec Linn. *Croton oblongifolium*, Del. Descr. Égypt. Hist. Nat. ii. Fl. Egypt. p. 139, t. 51, fig. 1 (1812); A. Juss. Tent. Gen. Euph. p. 28 (1824). *Chrozophora obliqua*, Müll.-arg. in DC. Prodr. xv. 2, p. 749, syn. Wall. 7716 G excl. (1866); Schweinf. Beitr. Fl. Aethiop. p. 235, Aufz. p. 262 (1867); Boiss. Fl. Orient. iv. p. 1141, syn. Schweinf. excl. (1879); Hook. f. Fl. Brit. Ind. v. p. 409, partim et quoad loc. Scinde [Stocks] tantum (1887); Aschers. et Schweinf. Ill. Fl. Égypt. p. 138 (1887); Balf. f. [Bot. Socotra] Trans. Roy. Soc. Edin. xxxi. p. 277, var. *frutescens*, Schweinf. incl. (1888); Penzig in Atti Congr. Bot. Genova, p. 359 (1892); Pax in Ann. Istit. Bot. Roma, vi. p. 183 (1895); Schweinf. in Bull. Herb. Boiss. vii. App. 2, p. 306, var. *angustifolia* ac var. *incisa* incl. (1899); Broun, Cat. Sud. Fl. Pl. p. 72 (1906); Cooke, Fl. Pres. Bomb. ii. p. 607 (1906); Blatter in Rec. Bot. Surv. Ind. vii. [Flor. Aden] p. 332, syn. Wall. 7716 G excl. (1915); non A. Juss., nec Schweinf. (1862). *Chrozophora tinctoria*, Schweinf. Beitr. Fl. Aethiop. p. 36 (1867); Balf. f. l.c. (1888); non A. Juss. *Chrozophora tinctoria*, var. *subplicata*, Boiss. l.c., partim et quoad loc. Kosseir [Schweinfurth] tantum (1879); Terraciano in Ann. Istit. Bot. Roma, v. p. 98 (1895); nec Müll.-arg. *Chrozophora subplicata*, Pax et K. Hoffm. l.c. p. 24, partim et quoad loc. Kosseir [Schweinfurth] tantum (1912). *Tournesolia obliqua*, Franch. in Morot, Journ. Bot. i. p. 135 (1887); O. Kuntze, Rev. Gen. ii. p. 621 (1891).

This species is characteristic of, and is almost exclusively confined to the sublittoral zone of the north-east coast of Africa and the south-west coast of Asia, along both shores of the Red Sea and the Gulf of Aden. On the African shore it extends from Suez to Obok and Jibuti, thence to Ras Asir and Socotra. On the Asiatic coast it extends from the Sinai Peninsula to Perim, thence to Muscat. Outside the area it has been once met with on the coast of Scinde but in no intervening locality; it may therefore in India be only a species introduced from Aden or Muscat. In the Sinai Peninsula the ash of the fruit is used in the treatment of suppurating wounds.

Africa. Egypt: Ajeraud, *Delile*! between Ajeraud and Suez, *Letournoux*! Suez, *Schweinfurth* Trigari, *Parlatore*! Wadi Nachel and Hendossa, near Kosseir, *Klunzinger*! Wadi om Mumfah, *Schweinfurth*! coast between Kossier and Ras Benass, at the foot of Mirza Sebara, *Schweinfurth*, 940! Wadi Gadireh, *Schweinfurth*, 945! 952! without precise locality, ? *Lippi in Herb. Jussieu*, 16265! Nubia: headland of Jebel Ferrajeh, near Berenice, *Schweinfurth*, 943! Jebel Garab and Jebel Dyb,

Lusson, 493! coast at Mirza Elei, *Schweinfurth*, 936! at Mirza Abu Amaneh near Ras Ranai, *Schweinfurth*, 937! *Bent*! Shadeh, near Suakin, *Schweinfurth*, 937 bis! Eritrea: Massowah, *Deflers*! Samhar, *Rensch in Herb. Hildebrandt*, 738! Arkiko, *Schweinfurth & Riva*, 142! Anfilah, between Ras Madir and Haressan, *Terraciano*. Abyssinia: Bembea, *Schimper*, 1692! Mēda, *Schimper*, 1692 bis! Edd, *Courbon*! Ennacoullon, *Courbon*, 323! Airuri, *Stecker*, 29! without precise locality, *Salt*! *Plowden*! Somaliland: Obok, *Faurot*! Berbera and vicinity, *Boivin*, 1074! *Révoil*, 131! *Drake-Brockman*, 69! 532! 533! 534! 535! coast near Lasgori and hills up to 3000 ft., *Rensch in Herb. Hildebrandt*, 860! Tokosha, *Ellenbeck*, 146! Socotra: near Tamarida, *Schweinfurth*, 358! *Balfour*, 133! near Galonsir, *Balfour*, 644!

Asia. Sinai Peninsula: Wadi Hebran, near Tor, *Ehrenberg*! *Kotschy in Herb. Schimper*, 359! between Tor and Sinai, *Bové*, 202! Sinai, *Botta*! *Drake*! *Jullien*! *Boissier*! Wadi Feiran, *Aucher*, 2004! *Lord*! Wadi Sarbat, *Hart*! Wadi Bedr, *Kaiser*, 30! *Wahab*! *Welsted*! Wadi Tihman, *Kneucker*! Arabia: Hedjaz; between El Wijh and Hamz-do-Kudian, *Burton*! Jeddah and neighbourhood, *Fischer*, 7! 58! *Kotschy in Herb. Schimper*, 993! *Zohrab*, 91! *Rensch in Herb. Hildebrandt*, 155a! *Kruijt*, 47! 79! *Botta in Herb. Drake*! Yemen; Tihama, 250 ft., *Deflers*! Gunfuden [Kunfuda], *Ehrenberg*! Haïs, *Botta*! *Bové*, 237! Lohaja, *Forskål*! Wadi Julúl, near Juma, *Lunz*, 31! Kamaran Island, *Faurot*! Aden; Shamsen, *Hooker*, 100! *Deflers*, 62! Aden, *T. Thomson*! *Wykeham Perry*! *Balfour*! *Schweinfurth*, 29! *Ralph*, 668! *Wiesner*! *Hildebrandt*, 783! *Rensch in Herb. Hildebrandt*, 784a! *Marshall Ward*! Biggari Valley, *Deflers*! Maala plain, *Lunt*, 347! Shukra, *Schweinfurth*, 70! Oman; Muscat, *Leclancher*, 32! *Aucher*, 5296! *Bornmüller*, 592! *Bent*, 101! *Dubuc*! India: Scinde; without precise locality, *Stocks*!

The locality Mayotte in the Comoro group given by Müller on the authority of a specimen in the Lenormand herbarium is erroneous. The field note which accompanies a specimen of this particular gathering (*Boivin*, 1074) shows that it was obtained by Boivin at Berbera in Somaliland. The Panjab locality cited by Pax and Hoffman and the Indian locality indicated by Müller are due to inadvertences; the specimens cited in both cases belong to *Chrozophora hierosolymitana*. There is some inconsistency in the citation by Pax and Hoffman of *Croton argenteum*, Forsk. (1775) non Linn.; *Croton obliquum*, Vahl (1790) and *Chrozophora obliqua*, A. Juss. (1826). The same actual specimen in the Copenhagen herbarium serves as the type both of Forskål's species and of that of Vahl; the type of Jussieu's species is another specimen of the same plant in the Jussieu herbarium written up as *Croton obliquum* by Vahl himself. Clearly therefore all three names must be cited under one species, not distributed under two. The species to which all three names belong is not *Chrozophora oblongifolia*. During the period from 1826, when Sprengel summarised the genus (*Syst. Veg.* iii.), to 1860, when T. Anderson gave an account of the Flora of Aden, there was no

confusion with regard to the name which the shrubby form of this plant should bear. The confusion between it and *Chrozophora obliqua* arose from some misapprehension on the part of Müller in 1866, which has been perpetuated since. The condition in which this species occurs during its first season has more than once led field-botanists to mistake it for the strictly herbaceous *Chrozophora tinctoria*, or for the prostrate form of that species, *C. tinctoria*, var. *subplicata*. The two plants are, however, readily distinguished when in ripe fruit because the capsules of *C. tinctoria* are red, those of *C. oblongfolia* are blue; when in flower because the anthers of *C. tinctoria* are about 10 (varying from 9-11), whereas those of *C. oblongifolia* are usually fewer than 8; even when without flowers or fruit, because the leaves of *C. tinctoria* are not much longer than broad and are repand or subentire, in *C. oblongifolia* are twice as long as broad and are usually lobed or incised. The degree of lobing is very variable as also is the width of the leaf-blade; on this account it is not possible to maintain the variety proposed by Schweinfurth in 1888 or the two varieties separated by the same author in 1899.

7. **Chrozophora tinctoria,** *A. Juss.* Tent. Gen. Euph. t. 7, fig. 25/1-11 (1824). Annua, herbacea; folia rhomboideo- vel triangulari-ovata, quam lata vix longiora, margine repando-dentata, rarius subintegra, utrinque parce tomentosa deinde scabrida subglabrescentia; antherae 9-11, saepissime 10; capsula matura rubro-purpurea, distincte muricata.

A widespread usually sublittoral species of the Mediterranean basin, extending beyond Gibraltar northwards on the Atlantic seaboard to the Tagus and beyond the Bosphorus northward on the Euxine coast to the Danube and the Crimea.

a. **genuina,** *Müll.-arg.* in DC. Prodr. xv. 2, p. 749 (1866). Erecta.—*Heliotropium majus,* Amat. Diosc. Enarrat. p. 437, partim (1554); ibid. ed 2, p. 741 (1558). *H. parvum*, Clus. Hist. Nat. p. ult. cum icon. (1557); Lobel, Hist. Stirp. p. 133 (1576). *H. minus*, Pinet, Hist. Pl. p. 637, partim (1561); Anguil. Sempl. p. 302 (1561); Camerar. Epit. Matt. p. 1001 cum icon. (1586); id. Hort. Med. p. 73 (1588); id. Kreutterb. p. 437a cum icon. (1611); Schmidt, Gesn. Op. Bot. t. 4, fig. 30 (1754). *H. minus quod et Tricoccon cognominant*, Gesn. Hort. Germ. p. 261 recto (1561). *H. vulgare Tournesol gallorum, etc.*, Pena et Lobel. Advers, p. 101 cum icon. (1570. *H. minus tricoccum*, Clus. Rar. Hisp. p. 395, cum icon. (1576); Bauh. Phytopin. p. 487 (1596). *H. tricoccum*, [Dalech.] Hist. Gen. Pl. ii. p. 1352 (1587); Bauh. Diosc. Matth. p. 893 cum icon. (1598); Bauh. Pin. p. 253 (1623); Ray, Hist. Pl. i. p. 185 (1686); Magnol, Bot. Monsp. p. 126 (1686); Tournef. Elem. i. p. 116 (1694). *Ricinis aliquo modo similis*, Magnol, Hort. Reg. Monsp. p. 173 (1697). *Ricinoides ex qua paratur Tournesol gallorum*, Tournef. Inst. rei Herb. App. p. 655 (1700); *idem, folio serrato non villoso,* Tournef. Cor. p. 45 (1703); Niss. Act. Acad. p. 339, t. 17 (1712). *Tournesol*, Magnol, Nov. Char. Pl. p. 274 (1720); Adans. Fam. ii. p. 356 (1763).

Croton tinctorium, Linn. Sp. Pl. p. 1004 (1753); Lamk Fl. Fr. ii. p. 198 (1778); id. Encyc. Meth. ii. p. 212, var. β et γ excl. (1786); All. Fl. Ped. ii. p. 47 (1787); Ucria, Hort. Reg. Panorm. p. 406 (1789); Lamk Ill. t. 740, fig. 4 (1790); Russell, Aleppo, ii. p. 265, partim (1794); Desf. Fl. Atl. ii. p. 354 (1798); Willd. Sp. Pl. iv. 1, p. 538 (1805); Geis. Crot. Monogr. p. 68 (1807); Ait. Hort. Kew. ed. 2, v. p. 327 (1813); Sibth. et Sm. Fl. Gr. Prodr. ii. p. 248 (1813); DC. Fl. Fr. iii. p. 347 (1815); Sab. et Maur. Fl. Rom. Prodr. p. 332 (1818); Ten. Fl. Nap. ii. p. 357 (1820); Sieb. Avis. p. 5, rem. p. 6 (1821); Urb. Enum. Pl. Arch. aut Port. Eux. p. 124 (1822); A. Juss. l.c. p. 28 (1824); Ten. Syll. p. 478 (1831); Chaub. et Bory, Exped. Mor. p. 274 (1832); id. Fl. Pelop. p. 64 (1838); Lindl. et Sibth. Fl. Gr. x. p. 40, t. 950 (1840); Gussone, Syn. Fl. Sic. ii. p. 617 (1845); Munby, Fl. Alger, p. 106 (1847); Gussone, Enum. Pl. Inarim. p. 295 (1854). *Tournesolia* [*tinctoria*], Scop. Intr. Hist. Pl. p. 243 (1777); Baill. Bot. Med. p. 932 (1884); O. Kuntze, Rev. Gen. ii. p. 621 (1891). *Ricinoides tinctoria*, Moench, Meth. Pl. p. 286 (1794). *Chrozophora tinctoria*, A. Juss. ex Spr. Syst. Veg. iii. p. 850 (1826); Spach, His. Veg. ii. p. 500 (1834); Reichb. Ic. Fl. Germ. et Helv. t. 4805 (1841); Marg. et Reut. Fl. Zante, p. 82 (1841); De Not. Rep. Fl. Ligus. p. 366 (1844); Colm. Cat. Pl. Catal. p. 139 (1846); Ledeb. Fl. Ross. iii. 2, p. 581, partim et quoad spec. Taurid. (1850); Vis. Fl. Dalmat. iii. p. 230 (1852); Guch-Delicata, Fl. Melit. p. 32 (1853); Bertol. Fl. Ital. x. p. 278 (1854); Gren. et Godr. Fl. Fr. iii. p. 101 (1855); Clem. Sert. Orient. p. 87 (1855); Payer, Organogén. p. 526, t. 110 (1857); Baill. Étud. gén. Euphorb. p. 322, t. 15, fig. 12-22 (1858); Moris, Fl. Sard. iii. p. 475 (1859); Munby Cat. Pl. Alger. p. 27 (1859); Heldr. Nutzpfl. Gr. p. 58 (1862); Munby, l.c. ed. 2, p. 30 (1866); Parlat. Fl. Ital. iv. p. 593 (1867); Raul. Crète Bot. p. 853 (1869); Letourn. Étud. Bot. Kabyl. p. 69 (1871); Boiss. Fl. Orient. iv. p. 1141 (1879); Willk. et Lange, Prodr. Fl. Hisp. iii. p. 507 (1880); Heldr. Fl. Cephal. p. 610 (1882); Battand. et Trab. Fl. Alger. p. 804 (1888); Colm. Enum. Pl. Hisp. Lusit. iv. p. 610 (1888); Velenov. Fl. Bulg. p. 502 (1891); Baldacci, Viag. Creta, p. 92 (1895); Velenov. l.c. Suppl. p. 248 (1898); Heldr. Chlor. Theras, p. 21 (1899); Halác. Consp. Fl. Gr. iii. p. 92 (1904); id. Suppl. p. 95 (1908); Dur. et Barr. Fl. Libyc. Prodr. p. 217 (1910); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 22, fig. 4 (1912).

Portugal. Estramadura: Setubal, *Herb. Kunth*! without precise locality, *Welwitsch*, 418! Alemtejo: Povoa. *Welwitsch*. Algarve: Silves, *Welwitsch*, 326! Serra do Arrabida, *Daveau*, 57! Serra do San Luiz; Vargem Valley, *Daveau*, 113!

Spain. Andalusia: Xeres, *Bourgeau*, 443! Puerto Santa Maria, *Bourgeau*, 2031! *van den Bosch*! Cartama, *Reverchon*, 255! Granada, *Rambur*! Agua Blanca, *Fimenes*! base of Sierra Nevada, *Bourgeau*, 1182! 1482! *Willkomm*, 372! Jaen, *Blanco*, 300! Murcia: Hellin, *Bourgeau*, 867! Valencia: Benicarlo, *Sennen*, 1023! New Castile: Madrid, *La Gasca*! *Reuter*! Leon: Salamanca, *Willkomm*! Old Castile: Fontiveros, *Willkomm*.

Aragon: Saragossa, *Echeandia*! Catalonia: Barcelona, *Huguenin*! *Compané*! Llers à Hostalets, *Sennen*, 168! Balearic Islands: Majorca; Soller, *Bianor*, 1237! Minorca, *Willkomm*.

France. Aude: Narbonne, *Mertens*! *Pourret*! Herault: Montpellier, *Herb. Linn.*! *Herb. Paris*! *Gerard*! *Bentham*! *Viguier*! Restinclières, *Bentham*! near Laverune, *Ramu*! Valargues, *Ball*! Gard: Manduel, *Herb. Paris*! *Naudin*! Nimes, *Herb. Paris*! *Svezzol*! Bouches du Rhone: near Marignac, *Loret;* Marseilles, *Roux*! *Schlanbusch*! *Treviranus*! Aix, *Grenier*. Vaucluse: Avignon, *Requien*! Basses Alpes: Montfort, near Sisteron, *Herb. Paris*! Riez, *Herb. Paris;* St. Auban, *Herb. Paris*! Digue, *Huguenin*! without precise locality, *Reverchon*! Var: Le Luc, *Huet & Hanry in Herb. Schultes*, 1139! Le Cannet, *Hanry in Herb. Billot*, 3470 bis! Pierrefou, *Chamberion in Herb. Billot*, 3470! Toulon, *Richard*! Roquebrun, *Bertrand*! Hyères, *Auzandie;* Grasse, *Herb. Paris*! Frejus, *Maire*! *Herb. Drake*! Alpes Maritimes: Nice, *de Notaris;* near Antibes, *Herb. Paris*! Corsica: Biguglia, *Salis*! *Dabeceau*! Ile Rousse, *Bernard*! between St. Florent and Bastia, *Soleirol*, 3761! St. Florent, *Mabille*, 270!

Italy. Sardinia: Sestu, *Müller*! Mandas, *Thomas*! Cagliari, *Barraud*! Sicily: Palermo, *Parlatore*! *Todaro*, 432! *Gussone*! Messina; Milazzo, *Nicotra*! between Leonforte and Castro Giovanni, *Heldreich*! Malta: Zeraffa, *Grech-Delicata*! Riviera: Ventimiglia; La Mortola, *Dinter*! *Berger*! San Remo, *Panizzi;* Bordighera, *Bicknell*! Diano Marina, *Ricca;* Porto Maurizio, *Gentile*! Oneglia, *de Notaris*. Roma: Rome, *Chiovenda*! *Pirotta*! Campania: Naples, *Regnier*! Island of Ventotana, *Bolle*! Calabria: Prostano, *Thomas*! *Gussone*! Faventia, *Magnogati*! Basilicata: without precise locality, *Tenore; Pasquale*. Apulia: near Manfredonia, *Porta & Rigo*! Abruzzo: base of Monte Marone, near Sulmona, *Leresche*! Pescara, *Levier*! *Kuntze*. Umbria: near Narni, *Ball*! The Marches: near Macerata and near Cape Specineti, *Narducci*! near Ascoli, *Orsini*. Emilia: near Rimini, *Caldesi*.

Austria-Hungary. Istria: near Trieste, *Tommasini;* Island of Lussin. *Romer*, 686! Dalmatia: Spalato, *Pichler*, 41! *Petter*, 123! *Studnicka*! Elfina, *Botteri*! Macarsca, *Stossich*! Lesina, *Setter*! *Hohenacker*, 281! without precise locality, *Botticelli*! Bosnia: Blagay, *Knapp*, 192!

Montenegro. Rijika, *Bierbach*!

Albania. Valmacu, *Baldacci*! near Hagios Vasilios, *Heldreich*! Prevesa, *Letournoux*!

Greece. Ionian Islands: Cephalonia; near Lari, *Heldreich*! Zante, *Margot;* Cerigo, *Speitz*. Moraea: Sparta, *Chaubard*! Argos, *Chaubard*! *Despreaux*! *Spruner*! Napoli, *Zuccarini*, 442! Crete: Girapetro, *Sieber*! Cape Drepano, *Raulin*! Atropopoulo, *Baldacci*, 269! Apocorona; Vamos, *Baldacci*, 141! Canea, *Reverchon*, 158! Cyclades: Melos, *Tournefort*! Mykonos, *Heldreich;* Tenos, *Heldreich*! without precise locality, *Chaubard*. Livadia: Attica; Athens and neighbourhood, *Berger*! *Engler*! *Orpha-*

nides, 25! *Heldreich*, 442! 1189! near Kephissia, *Heldreich*! Locris; near Vitrinitza, *Heldreich*! Sporades; Perestri, *Heldreich*! Thessaly: Tyrnova, *Sintenis*. Macedonia: near Litochori, *Sintenis*; Salonica, *Nadji*! *Adamowicz*!

Turkey. Thrace: Maku, *Adamowicz*! Constantinople, *Noë*, 306!

Bulgaria. Sadovo, *Stribrny*! without precise locality, *Frivaldsky*!

Russia. Crimea: Kapsichor, *Callier*, 197! Korbec, *Leveillé*!

Asia Minor. Bithynia: Broussa, *Thirko;* between Mardania and Broussa, *J. S. Mill*! Mysia: Island of Lesbos, *Sibthorp;* Yildiz, *Calvert*! Phrygia: Thymbra, *Calvert*, 146! without precise locality, *Warburg & Endlich*, 1172! Lydia: Smyrna, *Fleischer*! *Balansa*, 279!

Cyprus. Nicosia and neighbourhood, *Heldreich*! between Cerignia and Lapitho, *Sintenis & Rigo*, 624! near Omodos, *Sintenis & Rigo*, 627!

Syria. Aleppo: Genkún, *Peronin*! Marasch, 1000 ft., *Haussknecht*! Aintab, 2000 ft., *Haussknecht*! near Aleppo, *Russell*! Damascus: Haddat, *Ehrenberg*! Chlora, *Peyron*! Aley, *Peyron*! Beirut, *Peyron*, 698! *Post*! Palestine: Galilee; Shafa Hamr, *Post*, 217! Jerusalem, *Roth*! *Meyers*, 95 partly! Dead Sea, *Meyers & Dinsmore*, 395!

Egypt. Lower Egypt: Cairo and neighbourhood, *Delile*! *Ehrenberg*! *Raddi*! *Bové*, 374 partly! *Samaritani*! near Mansurah, *Samaritani*!

Cyrenaica. Derna, *Taubert*, 629!

Tunis. Zaghouan, *Kralik*! Djerba; El Kantara, *Kralik*! *Doumet-Adanson & Bonnet*! near Gourbata, *Letournoux*! Nabel, *Gandoger*, 18! Kerkenna Islands, *Espina*!

Algeria. Algiers, *Durieu*! Berreau, *Cosson*! Constantin, *Paris*, 274! *Buchinger*! *Dunkerley*! Sidi-ben-Omer, *Romain*! Philippeville, *Choulette*! Gambetta, *Debeaux*! Oran, *Durando*, 145! Tlemen, *Vignon*! Biskra, *Chevallier*, 512! Kabylie; Karrata, 2600 ft., *Reverchon*! Mount Magris, 3000 ft., *Reverchon*, 293! near Dellys, *Salle*, 142!

Morocco. Tangier, *Durand*, 57! *Salzmann*!

β. **subplicata**, *Müll.-arg.* in DC. Prodr. xv. 2, p. 749 (1866). Prostrata.—Boiss. Fl. Orient. iv. p. 1141, partim et spec. a Schweinfurth apud Kosseir lect. excl. (1879); Aschers. et Schweinf. Ill. Fl. Egypt. p. 138 (1887). *Chrozophora subplicata*, Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147, vi. p. 24 partim et spec. apud Kosseir et in Afghania lect. excl. (1912).

Egypt. Lower Egypt: Cairo and neighbourhood, *Ehrenberg*! *Bové*, 374 mainly! *Samaritani*! Bulaq and Takrur, *Schweinfurth* (*C. plicata* var. *transitoria*, Schweinf. MSS.)!

The typical variety, the 'Tournesol,' occurs in two somewhat different conditions as regards shape of leaf. One of the two, which is the more usual, corresponds with the plant from

Southern France figured by Clusius, and is to be met with everywhere from Portugal and Morocco to the Crimea and Egypt. The other, with less rhomboid leaves, which corresponds with the plant from Crete figured by Gesner, is met with especially in Greece, Crete and Syria. This latter form, when the leaves are more pubescent than usual, is apt to be mistaken for *C. hierosolymitana*, but the more numerous anthers and the less densely lepidote petals render its separation comparatively easy.

The prostrate variety from Egypt varies also in the shape and in the degree of tomentum of its foliage, but it does not, as Schweinfurth and Boissier have suggested, possess any character that would indicate this variety as being of the nature of a hybrid.

As the synonymy shows, writers from 1554 onwards have endeavoured to identify the Tournesol with one or other of two plants described by Dioscorides and with at least one plant described by Pliny. Among modern authors Geiseler in 1807 accepted the identification of the species both with *ἡλιοτρόπιον τὸ μικρὸν* of the Greeks and with *Heliotropion tricoccon* of the Romans. The only other authors to do this have been Pax and Hoffman, who in 1912 were prepared to accept the former but were doubtful about the latter determination: 'Diese Pflanze', they have remarked, 'war schon den Ärzten des klassischen Altertums bekannt; sie is das *ἡλιοτρόπιον μικρον* des Dioscorides und vielleicht das *Heliotropon tricoccon* des Plinius.''

Whether the plant which, according to Theophrastus (*Hist. Pl.* vii. 15. 1), was *τὸ ἡλιοτρόπιον καλούμενον* because it blossoms *ταῖς τροπαῖς*, be identical with one of those that Dioscorides believed (*Mat. Med.* iv. c. 190) to have received the name *ἡλιοτρόπιον ἀπο του συμπεριτρέπεσθαι τὰ φυλλα τῇ του ἡλιου κλίσει*, it would be unsafe to assert dogmatically. The circumstance that Theophrastus and Dioscorides offered different etymologies is no proof that they had different plants in mind; Link and Bentham have disagreed as fundamentally in their explanation of the name *Chrozophora*. The characters alluded to by Theophrastus are few and scattered. This was only natural in remarks addressed to readers who must have been familiar with the plant intended. Such as they are, however, these characters are precise; none of them are incompatible with the identity of his *ἡλιοτρόπιον* with *τὸ μέγα* of Dioscorides.

After the simultaneous appearance in 1554 of the editions of Dioscorides by Mattioli and Castell-Branco the former published a trenchant review of some of his rival's conclusions. It is singular that although they had come to different decisions as to the identity of *ἡλιοτρόπιον τὸ μέγα*, no comment was made by Mattioli. There would have been ample justification for the criticism, had it been offered, that, as there is nothing *καθάπερ σκορπίου οὐρά* about the inflorescence of the Tournesol, that plant could not possibly be *ἡλιοτρόπιον το μέγα*. Apparently the Tournesol was a plant with which Mattioli was not acquainted, and this may account for his silence.

The identification by Clusius of the Tournesol with *ἡλιοτρόπιον*

τὸ μικρὸν has just as little to be said for it as that suggested by Amatus. Though the account which Dioscorides gave of τὸ μικρὸν is much shorter than that given of τὸ μέγα, there is nothing in what Dioscorides has said which is inconsistent with the possibility that the two plants were closely alled. The mere fact that the account of τὸ μικρὸν is so brief, instead of justifying scholars, from the XVIth Century onwards, in treating the two plants as members of different natural families, suggests the probability that they were so much alike as to be best and most readily distinguished by the circumstance that whereas τὸ μέγα φύεται ἐν τραχέσι τόποις, τὸ μικρὸν φύεται ἐν τελματώδεσι τόποις καὶ παρὰ λίμναις. This conclusion, which is that most natural to the descriptive botanist, receives some support from the fact that no fewer than four of the known codices of Dioscorides give σκορπίουρον as a synonym of τὸ μικρὸν as well as of τὸ μέγα. No doubt all four may be due to some error on the part of copyists; on the other hand, all four may equally well indicate that early students of Dioscorides were aware that τὸ μικρὸν, like το μέγα, has an inflorescence 'curved like the tail of a scorpion.' That the latter is the more probable explanation is indicated by the fact that the great Vienna Codex supplies a portrait of τὸ μικρὸν which, although somewhat crude, undoubtedly depicts the species we now know as *Heliotropium supinum*, Linn. (*Sp. Pl.* p. 130).

On œcological grounds the suggestion of Clusius is even less satisfactory than that of Amatus, for the Tournesol at least does grow in dry places and does not, as Gerarde wrote, 'grow in fennie grounds and neere unto pooles and lakes.' This circumstance alone is sufficient to show that, by whatever name the Tournesol may have been known, if indeed, it were known at all, to Greek writers, it cannot have been the plant they knew as ἡλιοτρόπιον τὸ μικρὸν.

When Sprengel in 1830 (*Comm. Diosc.* ii. p. 642) accepted the view expressed by Lobel in 1576 (*Hist. Stirp.* p. 133) that the lesser Heliotrope of Dioscorides was the Tournesol, he was inadvertently led to believe that Gesner shared this opinion. What Gesner really did think was that the Tournesol might be the Heliotrope 'quod et Tricoccum cognominant,' alluded to by Pliny; the lesser Heliotrope of Dioscorides was regarded by Gesner as quite distinct and was identified by him with another plant. It will be noted that in the 'Pflanzenreich' Pax and Hoffman, while accepting the verdict of Lobel and Sprengel as regards the identity of the Tournesol with ἡλιοτρόπιον τὸ μικρὸν, have not felt so assured as to the accuracy of the view of Gesner and Lobel that the Tournesol is also identical with the *Heliotropion tricoccon* of Pliny.

The caution thus shown is pardonable. There is not a single character attributed by Pliny to either of the two *Heliotropia* referred to by him (*Hist. Mund.* xxii. c. 29) which justifies the serious descriptive botanist in regarding any one of them as identical with either of the two species discussed by Dioscorides. In both of the plants dealt with by Pliny the flower is blue: in both it follows the sun during daylight. We are, however, con-

cerned here only with the one which Pliny knew as *Tricoccon*, and although this plant also bore the name *Scorpiurum*, this was not because of its *ἄνθος ἐπικαμπὲς καθάπερ σκορπίου οὐρά* but because ' semen ei est effigie scorpionis caudae.' This latter character is in itself sufficient to render the identification suggested by Gesner untenable. But the applied botanist has even stronger grounds for the rejection of Gesner's view that the Tournesol is the ' Heliotropium minus quod et Tricoccum cognominant,' not only on account of what Pliny has stated, but on account of what Pliny has left unsaid. The plant Pliny had in mind was believed to possess the properties of a febrifuge; this alone should satisfy the least critical that his plant was not the Tournesol. On the other hand, the Tournesol is the source of a dye: had Pliny, who was nothing if not practical, been dealing with the Tournesol, it is inconceivable to the economic botanist that this outstanding character should be passed over.

8. **Chrozophora hierosolymitana,** *Spr.* Syst. Veg. iii. p. 850 (1826). Annua, herbacea, erecta; folia ovata vel subrhomboidea, quam lata vix longiora, margine distincte dentata vel subintegra, utrinque dense vel laxius velutina; antherae 4-5, raro 6-8; capsula matura rubro-purpurea, distincte muricata.—*Croton tinctorium*, Russell, Aleppo, ii. p. 265, partim (1794); non Linn. *Croton plicatum*, Sieb. Avis. Herb. Palaest. p. 7 (1821); non Vahl. *Croton oblongifolium*, Sieb. ex Spr. l.c. (1826); non Del. *Croton* sp., Wall. Cat. 7716 G (1830). *Chrozophora Sieberi*, Presl, Bot. Bemerk. p. 109 (1844). *Chrozophora tinctoria*, Ledeb. Fl. Ross. iii. 2, p. 581 partim et quoad spec. Caucas. (1850); Stewart, Panjab Pl. p. 193 (1869); King, Pl. N.W. Prov. p. 15 (1870); Aitch. Trans. Linn. Soc. Bot. n.s. iii. p. 108 (1880) et Journ. Linn. Soc. Bot. xix. p. 186 (1881); Hook f. Fl. Brit. Ind. v. p. 408 quoad spec. capsulis lepidotis tantum (1887); Watt. Dict. Econ. Prod. Ind. ii. p. 621 (1889); Kew Bulletin, 1889, p. 279 et 1896, p. 233; Lipsky, Act. Hort. Tifl. iv. [Fl. Caucas.] p. 446 (1899); Radde, Mus. Caucas. p. 154 (1901); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 22, partim et quoad spec. Bornmüller, 1270, Sintenis 1462, Becker, Schlangintweit 2624, Thomson (1912); non A. Juss. *Chrozophora tinctoriae* Adr. de Juss.? *affinis*, Bunge Rel. Lehm. p. 315 (1851), et Mém. Acad. Pétersb. vii. p. 491 (1854). *Chrozophora verbascifolia*, Baill. Étud. gén. Euphorb. p. 322, partim (1858); Boiss. Fl. Orient. iv. p. 1141, partim (1879); Pax et K. Hoffm. l.c. partim (1912); non A. Juss. *Chrozophora tinctoria*, β. *hierosolymitana*, Müll.-arg. in DC. Prodr. xv. 2, 749 forma *brachysepala* incl. sed spec. hispan. et graec. excl. (1866); Aschers et Schweinf. Ill. Fl. Egypt. pp. 773, 804 (1887). *Chrozophora obliqua*, Müll.-arg. l.c. partim et quoad Wall. 7716 G tantum (1866); Hook f. l.c. 409, spec. Scind. excl. (1887); non A. Juss. *Chrozophora subplicata*, Pax et K. Hoffm. l.c. p. 24 partim et quoad sp. afghan. [Griffith] tantum (1912).

This species is characteristic of and is widely spread throughout North-west India, the North-west Himalaya, Baluchistan, Afghanistan, Persia, Turkestan, Georgia, Eastern Asia Minor,

Mesopotamia, and Syria, with an isolated outlying centre in Western Arabia and another in Egypt. *Chrozophora hierosolymitana* has been included by many authors in *Chrozophora tinctoria*, which it often greatly resembles and of which it has the strongly muricate capsules, but from which it is readily distinguished by the usually fewer anthers and the always more densely lepidote petals. By a few authors this species has been merged in *Chrozophora obliqua* of which it has the anthers and the petals but which it very rarely resembles in general appearance. Even when *C. hierosolymitana* has the pannose pubescence of *C. obliqua* it is easily distinguished by the shape of the leaf blade and the larger, more muricate capsules.

In the Panjab this plant is sometimes collected and used as fuel (*Stewart*).

India. Upper Gangetic Plain: Muttra; Bindraban, *Hardwicke in Herb Wallich*, 7716 G! Panjab: Sirhind; Ambala, *Edgeworth*, 127! Firozpur, *Thomson*, 1473! Bari Doab; Amritsar, *T. Anderson*, 148! Lahore, *Thomson*, 1473 bis! *Brandis*, 2040! Rechna Doab; without precise locality, *Thomson*! Jech Doab; Shahpur, Thall Desert, 900 ft., *Ram Baksh in Herb. Drummond*, 6347! Sind-Sagar Doab; Salt Range, *Aitchison*! Ahmadabad, 900 ft., *Naran Das in Herb Drummond*, 6344! Rawal Pindi, *Aitchison*, 531/1092! *Schlagintweit*, 10945! Campbellpur, *Stewart*, 18! North-west Frontier Province: Waziristan; Tonk, *Duthie*, 7205! Gomal Pass, *Gage*! North-west Himalaya: Kashmir; without precise locality, *Thomson*! Gilgit; Kagushi, 5500 ft., *Giles*, 368! Chitral; Warai, 4500 ft., *Gatacre in Herb Duthie*, 17534!

Baluchistan. Quetta: Shela, 4800 ft., *Lace*, 4089! Teree, near Mastung, *Stocks*, 1079! Fort Sandeman, *Duthie*, 19007! Mekran: on the south coast at Kapotcham, *Pierce*!

Afghanistan. Kandahar: near Kandahar, *Griffith*, 681 (K.D. 4792)! Helmund River, *Aitchison*, 70! 732! Kabul: between Thal and Kurram, *Aitchison*, 425! Herat: Hari-rud Valley, *Aitchison*!

Turkestan. Samarkand: between Bokhara and Samarkand, *Lehmann*; near Samarkand, *Fedtschenko*!

Persia. Khorasan: near Meshed, *Bunge*! Luristan: without precise locality, *Aucher*, 5295! 5297! Arabistan: Mohammerah, *Noë*! Luristan: Chrysan Valley, *Haussknecht*! Irak-Ajemi: Ispahan, *Aucher*, 2008! Kashan, *Glover*! *St. John*! Teheran, *Casson*! Persian Kurdistan: near Avroman, *Haussknecht*! Azerbijan: near Khoi, *Szovitz*, 450!

Caucasia. Daghestan: Derbend, *Becker*, 72! 73! without precise locality, *Steven*! Georgia: Tiflis, *Radde*, 253! *Schumann*! *Metajowski*! Mugah, *Radde*, 328! Helenendorf, *Hohenacker*.

Asia Minor. Pontus: Amasia, *Bornmüller*, 1270 (issued as *C. tinctoria*)! 1770 (issued as *C. verbascifolia*)!

Mesopotamia. Turkish Kurdistan: Mardin, *Stapf*, 1462! Upper Euphrates, *Montbret*! Mossul: near Mossul, *Kotschy*, 441 partly! *Bauere*! *Haussknecht*! Bagdad: near Bagdad, *Schläfli*, 50! Kapp, *Aucher*, 2007!

Syria. Aleppo: Aintab, *Post*! near Aleppo, *Russell*! *Michaux*! Damascus: Doumer, *Gaillardot*! Damascus, *Aucher*, 2006! near ruins of Baalbec, *Blanche*, 587! Palestine: St. Jean d'Acre, *Labillardière*! Gethsemane, *Sieber* (type of *C. hierosolymitana*, Spr. and of *C. Sieberi*, Presl)!

Arabia. Hedjaz: Jeddah, *Zohrab*, 249! *Kruijt*, 287! Fatmeh Valley, *Fischer*, 202! *Schimper*, 1036!

Egypt. Upper Egypt: Assiout, *Fischer*!

Aucher, 2007, from Kapp on the Euphrates, and *Bornmüller*, 1270, from Amasia in Pontus, in externals bear a very close resemblance to *C. tinctoria*, but are readily separated by their stamens and petals. The isolated Arabian and Egyptian localities may be due to introduction as field weeds. In one gathering from Afghanistan, obtained by Griffith in fields and vineyards at Candahar, there are sometimes 12 anthers; this, however, is not due to the presence of more than 5 anthers in each of two normal whorls as sometimes happens in *C. tinctoria*, but to the presence of a third whorl as in the species of the *Plicatae* group. It is possible that it is owing to the presence of so many stamens that Pax and Hoffman have referred Griffith's plant to their *C. subplicata*. But all the flowers on Griffith's plants do not have so many stamens; most of them have 6-8 anthers in two whorls. Griffith in his field note indicates that his plant was erect, from 8 in. to 2 ft. high. The closely lepidote petals moreover, show that the plant is *C. hierosolymitana*.

In the Edinburgh herbarium a specimen of *C. hierosolymitana*, bearing the indication *Ritchie* 671, is unlocalised. Most of Ritchie's specimens were collected in the Concan or the Deccan whence *C. hierosolymitana* has never been recorded. The same is the case with *C. parvifolia* of which there is also in the Edinburgh herbarium an unlocalised specimen which bears the indication *Ritchie* 670. Both species are, however, common in the Panjab and the probability is either that Ritchie paid a visit, of which, however, there is no record, to the Panjab, or that he may have received these specimens as exchanges from some contemporary collector, perhaps from Edgeworth, who gathered one of these species at Ambala, the other at Multan, or from T. Thomson, who collected both species at Lahore.

9. **Chrozophora obliqua,** *A. Juss.* ex Spr. Syst. Veg. iii. p. 850 (1826). Annua, herbacea, erecta; folia oblonga, quam lata dimidio longiora, margine integra, minopere undulata, vel breviter dentata, utrinque dense tomentosa vel rarissime fere glabra; antherae saepius 4-5, raro 6-7; capsula matura rubro-purpurea, sparse breviter muricata.

A characteristic inland species of the Mediterranean region extending from Spain and Algeria eastward to Asia Minor.

Syria, Mesopotamia, Persia and Turkestan. In Tripoli the ashes of this plant are used in the preparation of gunpowder (*Rohlfs*).

a. **genuina.** Folia integra vel parum undulata rarissime breviter dentata, utrinque dense pannoso-tomentosa.—*Ricinoides ex qua paratur* Tournesol gallorum *folio oblongo et villoso*, Tournef. Cor. p. 45 (1703). *Croton argenteum*, Forsk. Fl. Aegypt.-arab. Cat. Aegypt. n. 491, p. lxxv (1775); non Linn. *Croton obliquum*, Vahl, Symb. Bot. p. 78 (1790); Willd. Sp. Pl. iv. 1, p. 539 (1805); Geis. Crot. Mongr. p. 71 (1807); A. Juss. Tent. Gen. Euph. p. 28 (1824). *Croton verbascifolium*, Willd. l.c. (1805); Geis. l.c. (1807); A. Juss. l.c. (1824). *Croton villosus*, Sibth. et Sm. Fl. Gr. Prodr. ii. p. 249 (1813); Lindl. et Sibth. Fl. Gr. p. 41, t. 951 (1840); non Forsk. *Croton patulus*, La Gasca, Gen. et Sp. Nov. p. 21 (1816). *Chrozophora verbascifolia*, A. Juss. ex Spr. Syst. Veg. iii. p. 851 (1826); Coss. Not. Crit. p. 179 (1848); Clementi, Sert. Or. p. 87 (1855); Coss. Voy. Bot. Alger. p. 91 (1856); Baill. Étud. gén. Euphorb. p. 322, partim (1858); Munby, Cat. Pl. Alger. p. 27 (1859); Heldr. Nutzpfl. Gr. p. 58 (1862); Munby, l.c. ed. 2, p. 30 (1866); Bois. Fl. Orient. iv. p. 1141, partim (1879); Willk. et Lange, Prodr. Fl. Hisp. iii. p. 507 (1880); Colm. Enum. Hisp. Lusit. iv. p. 611 (1888); Battand. et Trab. Fl. Alger. p. 804 (1888); Willk. et Lange. l.c. Suppl. p. 262 (1893); Heldr. Fl. Aegin. p. 389 (1898) et Chlor. Theras p. 21 (1899); Halác. Consp. Fl. Gr. iii. p. 93 (1904); Dur. et Barr. Fl. Libyc. Prodr. p. 217 (1910); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 26, partim, et syn. Sieb. ac Presl. necnon syn. *C. hierosolymitana*, Spr. excl. (1912). *Chrozophora integrifolia*, Bunge, Rel. Lehm. p. 314 (1851) et in Mém. Acad. Pétersb. vii. p. 490 (1854); Baill. l.c. (1858). *Chrozophora tinctoria a. verbascifolia*, Müll.-arg. in DC. Prodr. xv. 2, p. 748 (1866). *Tournesolia verbascifolia*, O. Kuntze, Rev. Gen. ii. p. 621 (1891).

South Europe. Spain: Andalusia; Motril, *La Gasca*; Lonja, *Winkler*! Murcia; near Murcia, *Guirao in Herb. Bourgeau*, 2307! between Totana and Palmar, *Bourgeau*, 1483! near Lorca and Orihuela, *Porta & Rigo*, 534! Castile; La Mancha, *La Gasca*. Italy: Calabria; Pellaro near Reggio, *Rigo*, 451! Greece: Moraea; Sparta and neighbourhood, *Chaubard*! *Pichler*! *Heldreich*, 1161! near the mouth of the River Eurotas, *Schultes*! Argos, *Chaubard*! Napoli and neighbourhood, *Chaubard*! *Zuccarini*, 441! *Schultes*! Attica; Athens and neighbourhood, *Sibthorp*! *Schultes*! *Spruner*! *Berger*! *Fritze*! *Leonis*! *Orphanides*, 26! *Heldreich*, 116! 1190! *Sartori*, 199! plain of Kephissia and Mount Pentelici, *Heldreich*! *Clementi*! Cyclades; Milo (Melos), *Gundel in Herb. Jussieu*! Santorin (Thyra), *Despréaux*! Crete; Candia, *Olivier & Bruguière*! Russia: Crimea; without precise locality, *Herb. Charkow*!

North Africa. Algeria: Biskra; Beni Mora, *Jamin*! near Biskra, *Cosson*! Fezzan: Mourzuk, Wadi Ghurbi near Charaig, *Oudney*! Tripoli: Rhadames, *Rohlfs*, 3! Beni Oulid, *Rohlfs*, 73! Egypt: Libyan Waste; Wadi Dachel, *Ascherson*, 2219! Lower

Egypt; Cairo, *Forskål*, 491! *Pfund*! Bidraschan, *Muschler*! without precise locality, *Wiest in Herb. Drake*!

Asia. Asia Minor: Mysia; valley of the River Rhodius, *Sintenis*, 168! Lydia; Kassaba plain east of Smyrna, *Balansa*, 296! near Magnesia, *Ball*! Caria; Ingless, *Mitchell*! Pisidia; Isbarta, *Heldreich*! Cyprus: Pera, *Gaudry*, 254! between Peristerona and Dali, *Sintenis & Rigo*, 811! Syria: Aleppo; Haman, *Sintenis*, 1449! near Antioch, *Post*! Damascus; between El Beida and Palmyra, *Post*! Barada Valley, near Damascus, *Burdet*, 48! Matala, *Reuter*! Palestine; Jerusalem, *Hanbury & Hooker*! Jericho, *Dinsmore*! Mesopotamia: Mossul, *Kotschy*, 413 *in Herb. Kew*! 449! Persia: Azerbijan; Tabriz, *Hay*! Kurdistan; Sihna and Avroman, *Haussknecht*! Irak-Ajemi; Teheran, *Buhse*! Fars; Rud-i-malu, *Stapf*, 592! Mahluga Lake, *Stapf*, 2191! Kerman; near Kerman, 6300 ft., *Bornmüller*, 4667! Turkestan: Karnap-tau, *Lehmann* (type of *C. integrifolia*, Bunge)! Askabad, *Litwinow*, 71! *Sintenis*, 1162! Kata-Kúrgan, *Rein*, 11! Tashkent, *A. Regel* (type of *C. tinctoria*, var. *albo-tomentosa*, Regel MSS.)!

β. **glabrata,** *Heldr.* Folia breviter dentata, primum secus marginem et parce secus nervos pilosa, mox omnino glabra; capsula vix muricata.—*Chrozophora glabrata*, Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 24, fig. 5 (1912). *C. tinctoria* var. *glabrata*, Heldr. in Parnassos p. 277, nomen (1899).

South Europe. Greece: Cyclades; Santorin (Thyra), *Sartori*, 186!

The typical form of *Chrozophora obliqua* has been so generally recognised as a distinct species that it has been described under no fewer than five different names by Vahl, Willdenow, Sibthorp and Smith, La Gasca and Bunge respectively. It had, however, already been distinguished from the ordinary Tournesol by Tournefort long before any of these names were used. From *C. tinctoria* it is easily distinguished by its very villous leaves, considerably longer in proportion to the width than those of the Tournesol, by its fewer stamens and its rather smaller, very slightly muricate capsules. It is not always so easily distinguished from *C. hierosolymitana* with which it agrees as regards the number of stamens though the leaves in the latter species agree more closely in shape with those of *C. tinctoria* and their tomentum when dense is quite unlike that of *C. obliqua* in being closely velvety and composed of much shorter hairs.

The variety from Santorin, though it is, as Pax and Hoffman justly remark, the most easily recognised of all the forms in the *Tinctoriae* group, nevertheless agrees in every respect save the absence of pubescence with *C. obliqua* and, although it is here treated as a distinct variety of that species, may only be a local condition of the true plant.

¶ 4. Senegalenses, *Pax et K. Hoffm. in Engl. Pflanzer.* IV. 147. vi. p. 20, *pro sectione* (1912). Petala ubi color indicatus kermesina; stigmata aurantiaca; capsula matura albescens,

squamis margine undulatis crebre obsita; semina laevia.—*Chrozophora* § 2, β. ii., Müll.-arg. in DC. Prodr. xv. 2, p. 750 (1866).

In the group *Senegalenses* the existence of six distinguishable forms has been indicated. Five of these are known from specimens; the sixth depends on a figure and is hypothetical.

1. The first form was collected by Adanson in Senegal. The leaves are dark green above, and there sparingly beset with long-stalked, long-rayed stellate hairs which soon disappear. The twigs and leaves beneath are densely persistently woolly with long-stalked, long-rayed stellate hairs. The leaves on the main branches are hastate and distinctly petioled, those on the twigs are short-petioled and never hastate; the fruiting calyx-lobes are shorter than the capsules; the petals are noted as scarlet or crimson.

2. The second form was also collected by Adanson in Senegal. The leaves are dark green above, at first nearly and soon quite glabrous. The twigs and leaves beneath are densely persistently adpressed-hoary with sessile, short-rayed stellate hairs. The leaves on the main branches are hastate and distinctly petioled, those on the twigs are short-petioled and never hastate; the fruiting calyx-lobes are shorter than the capsules; the petals are scarlet or crimson.

3. The third form was first collected by Ehrenberg in Nubia. The leaves are pale greyish green and are, like the twigs, densely persistently woolly on both surfaces with long-stalked, long-rayed stellate hairs. The leaves both on the main branches and the twigs are distinctly petioled; they may be somewhat 3-lobed or subentire but never are hastate; the fruiting calyx-lobes are as long as the capsules; the colour of the petals has never been noted.

4 and 5. The fourth and fifth forms were collected together by Kotschy in Kordofan, and were issued by Hochstetter as one species under the number 'Kotschy 25.' The leaves in both are greyish green or tawny, and in both, alike on the main branches and the twigs are distinctly petioled but never hastate. In both the fruiting calyx-lobes are as long as the capsules; in both the tomentum consists of sessile stellate hairs. But the character and the disposition of the tomentum differ in the two. In the fourth form the leaves are equally densely and persistently velvety on both surfaces, with long-rayed stellate hairs. In the fifth form the leaves are sparsely beset above with small persistent stellate hairs, beneath like the twigs they are densely persistently adpressed-tawny with sessile short-rayed stellate hairs.

6. The possibility of another form is suggested by the figure which accompanies the description of a form belonging to the *Senegalenses*, collected by Brocchi in Nubia. From the description it is clear that the plant intended is either the third form or the fourth, which of the two is left uncertain since it is not stated whether the hairs be stipitate or sessile. The figure, however, represents a plant with perfectly glabrous leaves and stems.

If the omission of the described tomentum be due to inadvertence there is no sixth form in the group; if the figure represent an actual specimen there is a sixth form.

The treatment accorded to these six forms has varied from time to time. In 1786 Lamarck based upon the first form his description of *Croton senegalense*, but cited the second form as representative of his species. This suggests that Lamarck regarded the two as conspecific, though he did not endorse with this name the specimen he had described, while he did so endorse the specimen which he cited.

Vahl, who realised the difficulty thus created, drafted a new description of *Croton senegalense* based on the plant cited by Lamarck; this description Geiseler published in 1807. The preparation of a new description suggests that Vahl regarded the first form as specifically distinct from the second, though he did express that view or authorise Geiseler to do so on his behalf.

A. Jussieu, however, in 1824 definitely decided that the first and second forms are specifically distinct; they constitute the two Senegal species of his summary. Later Desvaux, who had examined the same specimens, concluded that they only differ as two varieties of one species.

Ehrenberg, when he collected his specimens of the third form concluded that it represented a distinct species which he issued, but did not describe, as *Croton macrocalyx*.

In 1836, Visiani published as *Chrozophora Brocchiana* a species based on specimens from the same neighbourhood as that of *Croton macrocalyx*. Visiani's type cannot now be traced so that while it is probable that his plant, like that of Ehrenberg, belonged to the third form, the possibility that it may have belonged to the fourth cannot be wholly excluded. The fact that he intended the figure accompanying his description to represent the tomentose plant which he described, renders it almost certain that the absence from his illustration of any tomentum is merely due to some inadvertence on the part of the artist who prepared the plate.

In 1858, Baillon, who then knew the fifth form as well as the first and the second, treated the fifth (Kotschy's plant from Kordofan) and the second (Adanson's plant from Senegal), in both of which the tomentum is adpressed, as identical. But the first form (also obtained by Adanson in Senegal), which has a floccose tomentum, Baillon, following Desvaux, regarded as a distinct variety of that species.

In 1860, Baillon, dealing then only with the first and the second forms, reverted to the view held by A. Jussieu, and regarded the two as specifically distinct. The second form, with adpressed pubescence, he named *Chrozophora senegalensis;* the first, with floccose tomentum he united with *C. plicata*.

In 1862, Schweinfurth, dealing with the specimens of the third form collected by Hartmann in Nubia, recognised that form as specifically identical with, but as varietally distinct from *C. Brocchiana*, Vis. While Schweinfurth did not state, he seemed to imply by his partial repetition of Visiani's original figure that

typical *C. Brocchiana* should be a glabrous plant, our hypothetical sixth form. The third form, with leaves equally floccose-pubescent on both surfaces, became therefore *C. Brocchiana*, var. *Hartmanni*, Schweinf., and was so described and figured. At the same time Schweinfurth regarded the second form, with leaves floccose-tomentose on the under surface only, as yet another distinct variety of *C. Brocchiana*. By this decision Schweinfurth thus endorsed the view held by Baillon in 1860 and by Jussieu in 1824, that the plant described by Lamarck as *Croton senegalense* in 1786 is specifically distinct from the one described by Vahl as *Croton senegalense* in 1807.

In 1866, Müller again endorsed this view and included the second form, from Senegal, in the Nubian *C. Brocchiana*. But in place of the three varieties indicated by Schweinfurth, Müller now recognised only two. Schweinfurth's three varieties were distinguished with reference to the tomentum; his first variety having leaves glabrous on both sides, his second having them floccose on both sides, his last having them glabrous above and floccose below. Müller, paying no regard to the tomentum, united those specimens of our third form in which the leaves are 3-lobed with our second form in which the lower leaves are hastate, under the variety *Hartmanni*, treating the specimens of our third form in which the leaves are not 3-lobed and the hypothetical sixth form as typical *C. Brocchiana*. But while Müller was prepared to accept as *C. Brocchiana* a plant which, if correctly delineated, is without any tomentum he, following the action of Baillon in 1858, on the ground of their agreement as regards tomentum, united the second form and the fifth form as *C. senegalensis*.

In 1912, Pax and Hoffman followed Müller and Baillon as regards *C. senegalensis*. As regards *C. Brocchiana* they went one step further than Müller. They disregarded, as he did, the distinction drawn by Schweinfurth between plants with the leaves tomentose on both sides, on one side, and on neither side. They, however, further disregarded the character supplied by the shape of the leaf blade on which Müller had relied. As a consequence they have decided, and probably with justice, that what Schweinfurth had described as var. *Hartmanni* is, in fact, the original *C. Brocchiana*, Vis. The situation thus simplified is clearly expressed. The distinction between *C. senegalensis* and *C. Brocchiana*, as understood by Pax and Hoffman, depends on a single character, in *C. senegalensis* the tomentum consists of sessile, in *C. Brocchiana* of stipitate hairs.

In 1912, also, another view of the *Senegalenses* forms was published independently in the 'Flora of Tropical Africa.' The same character was used for purposes of diagnosis but was regarded as of varietal not of specific importance. Striking though it be, it was felt that it could not be deemed of greater consequence than a combination of characters which indicated a cleavage plane at right angles to that supplied by the stalked or sessile hairs. The characters relied on as primary were the manifest heterophylly, combined with a glabrous or nearly glabrous upper surface of a dark green leaf, and a distinctly shorter calyx-lobe

in one group of forms, as contrasted with uniformity of leaf-shape and petiole-length, a paler leaf always persistently hairy above, and a distinctly longer calyx-lobe in another group of forms. To one of these groups belongs *C. senegalensis*, A. Juss., to the other belongs *C. Brocchiana*, Vis. Within each of the two species thus recognised we find two distinct varieties, one with sessile, the other with stipitate hairs. It is not denied that Schweinfurth, Müller and Pax and Hoffman may be right in referring the first form to *C. Brocchiana*. But it is at least certain that Lamarck, Desvaux and Baillon were right in regarding this same form as part of *C. senegalensis*. If, as is possible, both groups of authors be justified in their action, it follows that *C. Brocchiana* is merely a form of one widespread and somewhat variable African species.

At the same time the two extreme forms *Croton senegalense*, Vahl, and *Croton macrocalyx*, Ehrenb., are so unlike each other and so easily distinguished that, until fuller study in the field is possible, it is better to recognise at least two species in the group. This is done here, and in doing so the method already adopted in the 'Flora of Tropical Africa' is followed. One modification of the arrangement there adopted is, however, essential. The sagacious and satisfactory conclusion arrived at by Pax and Hoffman, that *C. Brocchiana* var. *Hartmanni*, Schweinf. is, in fact, the true *C. Brocchiana*, Vis., necessitates the suppression of Schweinfurth's variety and at the same time shows that what in the 'Flora of Tropical Africa' was regarded as being Visiani's type must be relegated to the position of a variety.

Homophylla; folia pallide viridia, omnia distincte petiolata basi rotundata vel cuneata; calycis feminei segmenta capsula aequilonga:—	
Indumentum pannoso-floccosum pilis longe stipitatis	10. *C. Brocchiana.*
Indumentum nunc velutinum nunc adpressum pilis sessilibus vel subsessilibus	10*b*. „ var. *intermedia.*
Heterophylla; folia saturate viridia, inferiora distincte petiolata basi subhastata, superiora brevius petiolata basi obtusa vel cuneata; calycis feminei segmenta capsula breviora:—	
Indumentum adpressum pilis sessilibus	11. *C. senegalensis.*
Indumentum pannoso-floccosum pilis stipitatis	11*b*. „ var. *lanigera.*

10. **Chrozophora Brocchiana**, *Vis.* Pl. quaed. Aegypt. ac Nub. p. 39, t. 8, fig. 2 [icon. ob indumenti praetermissionem imperf.] (1836). Hornotina herbacea, diutina fruticosa, prostrata; folia omnia ambitu similia, distincte petiolata, pallide viridia; calycis feminei segmenta capsulis aequilonga.—Broun, Cat. Sud. Fl. Pl. p. 72 (1906); Pax et K. Hoffm. in Engl. Pflanzenr.

IV. 147. vi. p. 20, partim (1912). *Tournesolia Brocchiana*, O. Kuntze, Rev. Gen. Pl. ii. p. 621 (1891).

This species is widely spread throughout dry North Africa from Mauretania and Senegal to the Red Sea littoral; it is abundant in Nubia and the Sudan but is rare further west. In Kordofan the seed of this plant is the source of a non-drying, or 'sweet' oil (*Tippets*).

a. **genuina,** *Müll.-arg.* in DC. Prodr. xv. 2, p. 749 ampl. (1866). Folia utrinque pilis stellatis longe radiatis ac stipitatis dense pannoso-floccosa, nunc majuscula parum 3-loba nunc minora subintegra.—*Chrozophora Brocchiana*, Schweinf. Pl. quaed. Nilot. p. 9, t. 5*b* (1862), et Beitr. Fl. Aethiop. pp. 35, 262 (1867). *C. Brocchiana*, var. *Hartmanni*, Schweinf. l.c. t. 5 (1862); Müll.-arg. l.c. partim et quoad spec. Hartmann tantum (1866); Prain in Dyer Fl. Trop. Afr. vi. 1, p. 838 (1912). *Croton macrocalyx*, Ehrenb. ex Schweinf. l.c. (1862).

Mauretania. Atar, *Chudeau*!

Senegal. Senegambia: Podar, *Mathieu*! Upper Senegal: Timbuctoo; Belia, *Chudeau*! without precise locality, *Lécard*, 20!

Northern Nigeria. Bornu, *Oudney*!

Sudan. Kordofan: Bareis, on the Darfur frontier, *Pfund*, 492! near Goghan, *Broun*! without precise locality, *Colston*, 87! *Muriel*, S/106! *Tippets*!

Nubia. Dabbeh, *Ehrenberg*! Nedi, *Brocchi;* Bayuda, between Dabbeh and Khartum, *Hartmann*! Matamma; near Ssagadi, *Schweinfurth*, 835! near El Bak, between Berber and Suakin, *Schweinfurth*, 836! 839! without precise locality, *Rifaud*!

This variety occurs in two states; one, with larger leaves, usually has these more or less distinctly 3-lobed; the other has smaller and subentire leaves.

β. intermedia. Folia nunc utrinque pilis stellatis longe radiatis sessilibus velutina, nunc pilis stellatis breve radiatis sessilibus supra parcius vestita subtus dense adpresse cinereo-tomentosa.—*Chrozophora senegalensis*, Baill. Étud. gén. Euphorb. p. 322 partim et quoad Kotschy 25 tantum (1858); Müll.-arg. l.c. partim et quoad Kotschy 25 tantum (1866); Schweinf. Beitr. Fl. Aethiop. p. 262 (1887); Broun, Cat. Sud. Fl. Pl. p. 72 (1906); Pax et K. Hoffm. l.c. p. 21 partim et quoad Kotschy 25 ac Chevalier 1302 tantum (1912); nec A. Juss. *C. Brocchiana*, Prain, l.c. (1912); vix Vis.

Senegal. Upper Senegal: Timbuctoo, *Cheralier*, 1302! Rezaf, *Chudeau*! Badiagan, *Chudeau*!

Sudan. Kordofan: Abu Gerad, *Kotschy*, 25! near Goghan, *Broun*, 887! without precise locality, *Colston*, 98! Darfur, *Purdy*, 39!

This variety occurs in two somewhat different states; one with

long-rayed hairs which approaches closely to typical *C. Brocchiana*, the other with short-rayed adpressed hairs which approaches closely to typical *C. senegalensis*.

11. **Chrozophora senegalensis,** *A. Juss.* ex Spreng. Syst. Veg. iii. p. 850 (1826). Hornotina herbacea, diutina fruticosa prostrata; folia supra saturate viridia glabrescentia vel glabra, ambitu dissimilia, inferiora distincte petiolata basi subhastata, superiora minora, brevius petiolata, basi rotundata vel cuneata; calycis feminei segmenta capsulis breviora.

This species is widely spread throughout western dry North Africa from Mauretania to Northern Nigeria; it has also once been met with in Nubia.

α. **genuina.** Folia subtus pilis stellatis breve radiatis sessilibus dense adpresse incano-tomentosa.—*Croton senegalense*, Lamk Ency. Meth. ii. p. 212 quoad plantam citatam sed descr. excl. (1786); Willd. Sp. Pl. iv. 1, p. 554 (1805); Geis. Crot. Monogr. p. 45 (1807); A. Juss. Tent. Gen. Euph. p. 28 (1824). *Chrozophora senegalensis*, Presl. Epimel. Bot. p. 213 (1849); Baill. Étud. gén. Euphorb. p. 322, partim et quoad Adanson 156 tantum (1858); Baill. Adansonia i. p. 67 (1860); Müll.-arg. in DC. Prodr. xv. 2, p. 749 pro parte maxima sed Kotschy 25 excl. (1866); Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 21, pro parte maxima sed Kotschy 25 et Chevalier 1302 excl. (1912); Prain in Dyer, Fl. Trop. Afr. vi. 1, p. 837 (1912). *Tournesolia senegalensis*, O. Kuntze, Rev. Gen. Pl. ii. p. 621 (1891).

Mauretania. Between Biark and Tin-Amatou, *Chudeau*! Ksar-el-Barka, *Chudeau*! Tamra, *Chudeau*! Guimi, *Chudeau*! Foum-Joul, *Chudeau*!

Senegal. Senegambia: Walo and Cayor, *Heudelot*, 419! Walo, *Perrottet*, 738! Dagana, *Leprieur*, 1194! Bakel, *Collin*, 101! between Bakel and Fangalla, *Carrey*, 18! Dakar, *Thiebaut*, 191! Galam, *Adanson*, 61! Kaolakh, *Kaichinger*, 48! without precise locality, *Adanson*, 156! Upper Senegal: Timbuctoo; Babog, *Chudeau*! marshes of Sienso, near San, *Chevalier*, 1051! Bongoumi, *Chevalier*, 687!

Dahomey. Alacora Mountains; near Jomba, 1200-2000 ft., *Chevalier*, 24078!

Northern Nigeria. Gando; Saie, 560 ft., *Barter*, 3444! Katagum district, *Dalziel*, 205!

Sudan. Bagirmi: Corbol, *Chevalier*, 9271! Makénia, *Chevalier*, 9671! Barambo, *Chevalier*, 9946! Wadai: Fort Lemy, *Chevalier*, 10362!

β. **lanigera,** *Prain* l.c. (1912). Folia subtus pilis stellatis longe radiatis ac stipitatis dense pannoso-floccosa.—*Chrozophora senegalensis*, var. *β.*, Desv. ex Baill. Étud. gén. Euphorb. p. 322 (1858). *Chrozophora plicata*, Baill. Adansonia, i. p. 67 partim

(1860); non A. Juss. *Chrozophorae Brocchianae forma forsan propria*, Schweinf. Pl. quaed. Nilot. p. 10 (1862). *Chrozophora Brocchiana*, *a. Hartmanni*, Müll.-arg. l.c. pro parte maxima (1866); non Schweinf. *Croton lanigerum*, Perr. ex Prain l.c. (1912).

Senegal. Senegambia: Dagana, *Leprieur*! near Richard-Tol, *Lelièvre*! Dakar, *Chevalier*, 2620! 15787! Tomboukana, *Chevalier*, 3464! Cape Verde; between Kan and Wochan, *Brunner*, 108! Galam, *Adanson*, 60! without precise locality, *Perrottet*, 42! 735! *Roger*! *Richard*!

Dahomey. Without precise locality, *Gironcourt*, 112.

Northern Nigeria. Borgou: near Fakoum, *Barter*, 812! Nupe: Jeba, *Barter*!

Nubia. Berber, *Acerbi in Herb. Delessert*!

Excluded Species.

Chrozophora mollissima, *Spr.* Syst. iii. p. 851 (1826) based on *Croton mollissimus*, Geis. Crot. Monogr. p. 73 (1807) is *Mallotus ricinoides*, Müll.-arg. as pointed out by Müller in 1866 and by Pax and Hoffman in 1912.

Native of South Eastern Asia; occurs in Burma, China and Malaya.

Chrozophora peltata, *Labill.* Sert. Austr.-Caledon. p. 74, t. 75 (1825) is, as pointed out by Müller and Pax, *Codiaeum Inophyllum*, Müll.-arg. (1866) based on *Croton Inophyllum*, Forst. (1786).

Native of New Caledonia.

Chrozophora Warionis, *Coss.* in Batt. et Trab. Fl. Alger. p. 804 (1890) accepted by O. Kuntze as *Tournesolia Warionii*, in Rev. Gen. Pl. ii. p. 621 (1891) has been transferred to *Euphorbia* by Pax and Hoffman as *E. Warionis*, in Pflanzenr. IV. 147. vi. p. 27 (1912). This is the correct genus for the plant which, however, is not, as Pax and Hoffman suggest, a new species, but is one that was first described a century earlier as *E. malacophylla*, the synonymy being:—

Euphorbia malacophylla, Clarke Trav. ii. p. 354 (1812); Spr. neue Entd. iii. p. 161 (1822); Spr. Syst. Veg. iii. p. 791 (1826). *E. lanata*, Sieb. ex Spr. Syst. Veg. iii. p. 792 (1826); Boiss. in DC. Prodr. xv. 2, p. 101 (1862). *E. syriaca*, Spr. Syst. Veg. iii. p. 792 (1826). *E. Warionis*, Pax et K. Hoffm. in Engl. Pflanzenr. IV. 147. vi. p. 27 (1912). *Chrozophora Warionis*, Coss. in Batt. et Trab. Fl. Alger. p. 804 (1890). *Tournesolia Warionii*, O. Kuntze, Rev. Gen. ii. p. 621 (1891).

Native of Cyprus, Syria and Algeria.

VIII.—THE WEST AFRICAN OIL PALM.

(*Elaeis guineensis*, Jacq.)

Reference has already been made in the *Bulletin* to the questions of the breeding of improved varieties of the Oil Palm in connection with the discovery of thin-shelled and practically shell-less forms of this palm, and it has been pointed out that experiments were needed to test whether the different forms of the oil palm would breed true to character from seed. (See *Kew Bull.* 1909, p. 47). In the Report of the Agricultural Department of the Gold Coast for the year 1916, which has recently been published, some interesting information is given which it is hoped will be followed up by further careful experiment. On p. 50 of the Report dealing with the experiments at the Kibbi sub-station, which were started in 1912, it is recorded that both the Abetumtum and Abepa varieties gave nuts apparently true to type, but the Abobobe, the soft-shelled variety, gave both hard- and soft-shelled nuts in the same bunches. It was further noted that the bunches of nuts yielded by this variety were much smaller than those of any other forms.

The following particulars are given of the yield in bunches of fruit from the palms planted in 1912:—

Abetumtum:—9 plants, 11 bunches, average weight 7 lbs.
Abepa:— 17 plants, 19 bunches, average weight 5 lbs.
Abobobe:— 19 plants, 19 bunches, average weight $3\frac{3}{4}$ lbs.

All the bunches were very small in size.

Before any answer as to the true breeding of the different varieties can be given, it is clear that more careful experiments must be devised.

In the first place hand-pollination of a variety with pollen from a plant of the same variety or from the male inflorescence of the same tree must be undertaken. No reliance can be placed on seed promiscously collected from any particular tree since cross-fertilization of trees of different type is constantly going on and the resultant offspring from such crossed trees will exhibit hybrid characters. A brief reference to the need of investigation of the various biological problems involved in any questions as to the future developement of the oil palm industry is also given in the Report of the "Committee on Edible and Oil-Producing Nuts and Seeds," 1916. Cd. 82-47.

Cultivation.

The oil palm in West Africa is, as a rule, subjected to no special cultivation and it is therefore all the more interesting to learn from the Gold Coast Report that palms subjected to proper cultural conditions have responded by a marked increase in the yield of fruit. (See Report, 1916, p. 53).

At Peki Blengo sub-station, oil palms are abundant and they have been thinned only when and where required.

One plot of 5 acres has been set apart for their cultivation and has been cleaned, the palms being thinned to a reasonable distance apart. In addition, there are odd palm trees scattered about

the station growing in land which is under definite cultivation for other crops and the marked effect of good treatment on these trees is shown in the following table.

	No. of bearing Palms.	No. of bunches.	Weight of bunches.	Weight of clean fruit.
			lbs.	lbs.
5-acre plot	357	223	4,355	2,737
Odd Palms	224	805	13,071	8,217

In both cases the yield is considerably in excess of the previous year, the return from the scattered palms being quite remarkable. It should be noted that the 5-acre plot has not yet been under soil cultivation.

Oil palm cultivation is being taken up outside West Africa and promising results are indicated in the Agricultural Bulletin, Federated Malay States, vol. v., Nos. 11 and 12, 1917, p. 439. Several acres of *Elaeis guineensis* were planted at the Kuala Lumpur experiment station in December, 1912, and a number of these plants began to form fruits towards the end of 1916.

Further evidence of early fruit production in Malaya is afforded by a number of 8-year old trees which came into bearing in their fifth year. Records of the individual yields of these palms have been kept over the past three years, and these are said to compare favourably with yields obtained in Africa. It would appear, therefore, from the evidence of the beneficial effect of good cultivation in West Africa that there may be a future for an oil palm industry in certain parts of Malaya where conditions are suitable.

In this connection the results obtained in the Seychelles with the cultivation of the African oil palm are of particular interest as is shown by the following account taken from the Annual Report on Agriculture and Crown Lands, Seychelles, for the year 1916, p. 2.

"The results hitherto obtained with another introduced palm (*Elaeis guineensis*) warrant its being also cultivated to a large extent, as already recommended in 1912. This palm, which produces several articles of commerce such as palm oil and palm kernels, has found in Seychelles the very soil and climate which it requires. This is no wonder as palms form 75 per cent. of the jungle trees on the hills. This year a bunch weighing 48 lbs. was obtained from a tree growing in rocky ground at the Botanic Station. The number of fruits on the bunch was as much as 2392 and each fruit was fully developed and perfectly ripe; a bunch of this size yields as much oil as 25 coconuts. This bunch hardly projected from the axils of the subtending leaf, and there was no apparent sign of such an enormous crop of fruits for a person standing under the tree. The fruits are so good to eat that all the employees and labourers of the Botanic Station are very fond of them, besides the Ashanti political prisoners who are regular visitors of the garden in search

of a new cluster. Plants of the soft-shelled variety introduced from Nigeria were set out in January, 1915, and in January, 1917, not only male flowers but also small bunches of fruits were produced. The other hard-shelled variety, which produces occasionally the enormous clusters mentioned above is not so precocious, although plants, $2\frac{1}{2}$ years of age, were seen this year producing fruits. I do not know if such results are obtained in other colonies, but in the literature on the subject at least 5 years are mentioned as the period of time required by the plant to come into bearing. It is to be hoped that an enterprising planter will set out a large plantation as soon as possible. Numerous small plots have been planted out on the Crown Lands. In West Africa, where this palm is indigenous, it is considered quite as productive as the coconut palm if not more so. There is not the least idea in my mind to recommend it as a substitute for the coconut palm in Seychelles. But the latter palm is so much handicapped by diseases that it is surely worth while to grow side by side with it as an adjunct another palm, nearly allied to it and quite as productive, on soils not already occupied by the former. As all the copra of this Colony is exported there is little left in the way of oil cake residues (poonac) for poultry feeding. Palm oil would be instrumental in supplying such a by-product, as the oil will have to be extracted locally, and it would, besides, produce a fruit of no small dietetic value for the poorer inhabitants."

The precocity in bearing of the Seychelles plants is remarkable, and the islands no doubt are well suited for the cultivation of the oil palm.

From a report by Mr. P. R. Dupont, Curator, Botanic Station, Seychelles, dated December 1st, 1917, forwarded by His Excellency the Governor, through the Colonial Office, to Kew, we learn that only three of the soft-shelled palms raised in 1912 from S. Nigerian seed, have as yet flowered and fruited, though the majority are now developing female branches. Of the three which have borne fruit, the shell in two cases was very thick, but one tree at the Botanic Station produced nuts with very thin shells, which, however, were smaller than usual. The nuts borne by one of these three trees weighed as much as 14·5 grammes each.

From this experience it is evident that no reliable results can be expected from promiscuously-collected seed of any particular variety, since such seeds are doubtless the results of the fertilisation of the female flowers of a thin-shelled palm with pollen from a thick-shelled variety.

It is to be hoped, therefore, that a well-planned series of experiments will be undertaken to investigate the various problems connected with the breeding of the best varieties of the oil palm now awaiting solution. The problems are not simple, since it is requisite not only to breed palms which bear easily-broken shells, but also to produce varieties which shall be prolific bearers of fruit yielding the finest quality oils.

So far as West Africa is concerned, however, the chief interest of these reports from the Seychelles lies in their confirmation of the information from other sources of the possibility of the estab-

lishment there of plantations of oil palm similar to those which are understood to have already been established in various Malayan colonies, both English and Dutch.

In the case of other staples derived, as the products of the oil palm in Africa are, from the forest, the establishment of plantations, with their more satisfactory economic conditions, has involved the collapse and disappearance of the cruder industry. Unless, therefore, the Governments of the West African Colonies take steps, and at once, to bring about the establishment of the cultivation of the oil palm as a plantation crop under regular agricultural conditions, this important tree may cease to be a means of livelihood for their subjects and a source of revenue for themselves.

IX.—MISCELLANEOUS NOTES.

Mr. Donald Halkerston, a temporary Sub-foreman in the Royal Botanic Gardens, Kew, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, an Assistant District Agricultural Officer in the Department of Agriculture, Uganda.

Gaston Allard, of Angers.—Early in January the famous Arboriculturist of Angers—M. Gaston Allard—died at his home, La Maulévrie, aged nearly 80 years. The writer is almost certainly the last Englishman to see him. I went to Angers for the first time last autumn and little expected to see the founder of the famous garden, as I knew that for several years M. Allard had been in a very feeble and precarious state of health. Professor Sargent, who, of course, was already well acquainted with the Allard collection of trees and shrubs, had asked me to accompany him to France, and to Angers in August, 1914, but the outbreak of the war put an end to the project. In the early part of October, while visiting M. Allard's neighbour, the Marquis de Charnacé, I was enabled to carry out this plan.

I found M. Allard sitting with a friend on a seat in the garden on the sunny side of his pleasant country house, and after telling him I had come from Paris to see his famous trees he insisted on showing me himself the plants he knew and loved so well. He was nearly blind and exceedingly frail and could not speak above a whisper, but notwithstanding his weakness he took me to the specimens I especially wished to see. *Populus euphratica*, one of the few in cultivation, he pointed out as not likely to long outlive himself. A new red-flowered jasmine and *Idesia polycarpa* in splendid fruit were the next treasures that he wished me to appreciate; in the case of the latter he had grafted the male and female plants on the same stock. Of his oaks he was especially proud, as well he might be, the collection being a very complete one, especially of Eastern American species. He showed me a *Quercus libani* bearing its large acorns profusely and insisted on my filling my pockets with them as well as with the ripe fruits of a hybrid *Torreya nucifera* crossed by himself with *T. myristica*.

It was interesting and very touching to see how his vigour seemed to return the further he went among his beloved trees.

M. Allard, after leaving school, entered as a student the École d'Agriculture de Grand Jouan where he learned his botany, which led him some years later to establish his Arboretum.

He travelled extensively for three years in Algeria, Tunis and Morocco, when he made the flora of those countries his especial study, at a time when travel there was a matter of much difficulty and some danger.

He began to prepare the ground for the Arboretum at Angers in 1858, and the first plantings were made in 1863. To-day the Arboretum contains a full collection of trees from North America, China, Japan and the Mediterranean littoral.

He has bequeathed this collection of half a century to the Pasteur Institute, and it is expected that his house will be used by the Institute as a laboratory of vegetable biology. Doubtless he felt that this was a more certain way to preserve it to posterity than of leaving it to the Angers Municipality, an elective body.

M. Allard's garden, though well-known to British tree-lovers, is not, I think, so well-known in France. Few of his fellow-townsmen were aware of the great fame of his collection. Let us hope that its new owners will bestow the same skill and thought upon its care and enrichment as M. Allard himself would wish for it.

F. R. S. BALFOUR.

In this country we have probably only one person, the Earl of Ducie, who, in the success and extent of his plantings and the length of time over which they have extended, has a record equalling that of M. Allard.

M. Allard never advertised his successes and it is perhaps due to his modesty that relations between him and Kew were not established until late in his life. In recent years his collection has been visited by officers of this establishment and they were always welcomed with charming courtesy.

Miss Ethel Sargant, F.L.S.—The premature death of Miss Sargant on January 16th, is an irreparable loss to English Botany. She carried on her first original researches in the Jodrell Laboratory, in 1892-3, and her work at that time was mainly on cytological questions. In particular she gave much attention to the subject of centrosomes, and was unable, like all other observers, to confirm their presence in the higher plants, as maintained by Guignard. Several papers on nuclear division were the fruit of her observations begun at Kew. She was the first to demonstrate in this country the truth of Navaschin's discovery of Double Fertilisation in Angiosperms. While at Kew she also published, in conjunction with the Hon. Keeper, a memoir on the Pitchers of *Dischidia Rafflesiana*, Wall. (Ann. Bot. vii, 1893). In later years Miss Sargant turned her attention to the comparative anatomy of seedlings, obtaining much of her material from Kew, and in this field met with striking success, elaborating a theory of the origin of Monocotyledons, which has exercised considerable influence on contemporary opinion.

Miss Sargant was an exceptionally skilled observer, and her work was of the highest degree of accuracy. Her style in writing her papers was as clear and vigorous as her observation was exact.

D. H. S.

Boissier Herbarium.—A letter received at Kew from Professor Chodat contains the important announcement that the famous herbarium accumulated by Mr. E. Boissier, after his death the property of his son-in-law the late Mr. W. Barbey, along with the fine library attached to the collection, has been presented by the legatees of Madame Barbey, whose death took place in January last, to the Botanical Institute of the University of Geneva. The collections and the library are to be transported to the University. Mr. Beauverd, the present curator of the herbarium will continue in office after the transfer.

Himalayan Exploration.—A valuable contribution to our knowledge of Himalayan geography, and at the same time a graceful appreciation of Sir Joseph Hooker's services in the same field, has been published by Lieut.-Col. W. J. Buchanan, I.M.S., C.I.E., in a paper* which appears in volume xiv. of *Bengal Past and Present*, and of which the author has sent a reprint to Kew. In a paragraph preliminary to a brief biographical sketch of Sir J. D. Hooker, Lieut.-Col. Buchanan writes: "In the course of many wanderings through Sikkim I have found Hooker's book, *Himalayan Journals*, such a source of pleasure and so generally accurate as a guide-book that it has been my custom for some years past to make notes of places passed, seen or described by Hooker, and have thus noted in many parts of his book changes of name, changes of spelling and alteration in routes, paths and roads, that it recently seemed to be worth while to attempt to follow Hooker in his great tours in Sikkim and to indicate where necessary the few mistakes which he made, as discovered by other and later travellers or by my personal observations."

An account of several tours described in Hooker's work follows, with numerous annotations that should be of great assistance to readers of the Journals who are likely to be perplexed in attempting to follow the author's route on recent maps, in which changes of names of places or variants in spelling of such names are frequent. An interesting note on Mount Everest is appended to the discussion on Hooker's references to the group of peaks which includes the world's loftiest mountain. Hooker, of course, did not use the name Mount Everest in his Journals, for it was not till after his return from India that the name, which has occasioned so much controversy, was proposed by Sir Andrew Waugh, then Surveyor-General of India, in compliment to his predecessor in office and the founder of the Indian Trigonometrical Survey, Sir George Everest. The opinion held at the time was that the peak had not a native name, and Lieut.-Col. Buchanan is a supporter of this view, while some authorities affirm that it possesses

* "In the Footsteps of Hooker through Sikkim and Nepal." 24 pp. and 4 plates. 4to. [Calcutta, 1917.]

at least two native names, an Indian name in Gaurisankar and a Tibetan one in Chomokankar or Jamokangkar, the first having been adopted by many continental geographers. Apparently neither of these names was known to Hooker, and the Nepalese name Tsungau, which he mentions in his reference to the Mount Everest group of peaks, is shown by Colonel Waddell to apply to the whole group and not to a particular summit. It seems probable that Hooker did not distinguish Mount Everest, for he describes more particularly what is believed to be Makula which, from his point of view, was the more conspicuous. Lieut.-Col. Buchanan's paper is provided with two photographs, one of the Everest-Makula peaks and the other of Kinchinjanga, Kubra and Pandim. It includes also a sketch-map of peaks and ranges seen from Senchal, Darjeeling, and a diagram of the famous snow peaks. The references to the *Himalayan Journals* are to the 1905 re-issue of the Minerva Library edition in one volume, first published in 1891.

Distribution of Encephalartos Hildebrandtii.—In the *Kew Bulletin*, for 1914, p. 386, the discovery of this interesting Cycad at Dar-es-Salam, in 1868, by Sir John Kirk and its rediscovery by Dr. J. M. Hildebrandt some time between 1868 and 1874, in some unspecified locality on the East African coast between Zanzibar and Mombasa, have already been recorded. The area of distribution, so far as the material and authentic records then available warranted a judgment, included the island of Zanzibar where, according to Werth, it is one of the species met with in the bush on the recent coral formation, and a narrow belt on the eastern coast of Africa for about 200 miles from Dar-es-Salam northwards to just beyond Mombasa. It is not, however, strictly confined to the actual coast zone. One locality, recorded by Dr. Stuhlmann, is Rosako, 17 miles inland from Bagamoyo; another, recorded by Dr. Holst, is Simbili in Tanga, about 15 miles inland from the town of that name; while one of Hildebrandt's localities —Shangamui, where he collected this Cycad a second time in 1876—is 12 miles inland from Mombasa. Moreover, Professor Engler collected the species in the valley of the Upper Bombo River, 45 miles inland from Tanga.

Since 1914 Werth's record for Zanzibar has been confirmed by specimens in the Paris herbarium collected in that island by Père Sacleux; specimens sent to the British Museum by the Rev. J. Taylor from the Rabai hills show that it extends along the coast belt to the north of Mombasa; more interesting still the species was noticed by Lieut.-Col. Molyneux while travelling from Voi to Mombasa, and at his instance material sent to Kew by Mr. H. Powell from Samburu shows that in Seyidieh the species extends at least 50 miles inland from Mombasa.

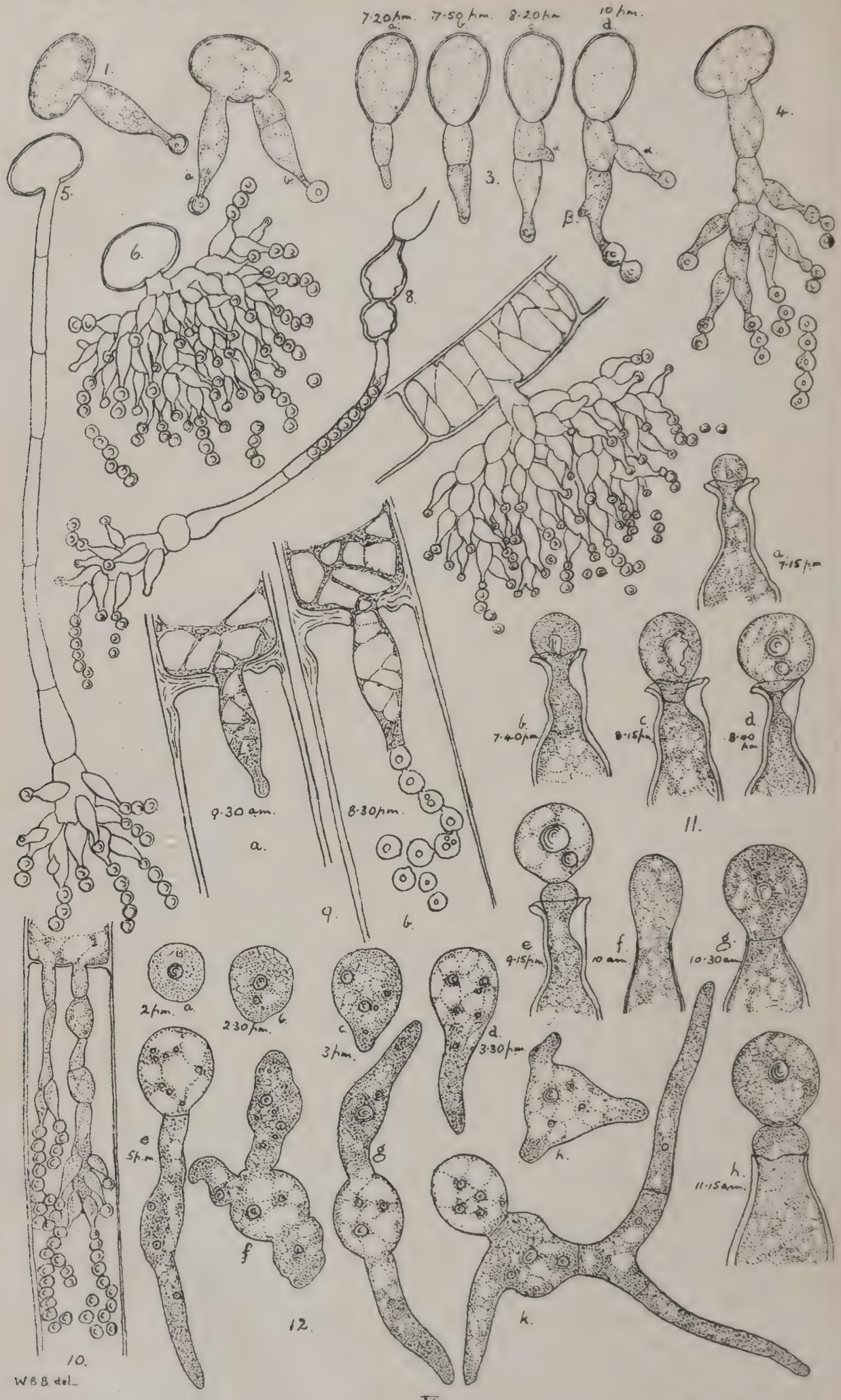
All these localities, as to the authenticity of which no doubt is possible, have been recorded in the *Flora of Tropical Africa*, vol. vi. sect. 2, recently published. It is, however, almost certain that the area of which *Encephalartos Hildebrandtii* is a characteristic species is wider than the localities enumerated indicate. In his "Travels in the Coastlands of British East

Africa and the islands of Zanzibar and Pemba," published in 1898, Mr. W. W. A. Fitzgerald refers on more than one occasion to the occurrence of a Cycad. Although Fitzgerald was aware of the introduction of *Encephalartos Hildebrandtii* to Kew by Sir John Kirk (*Travels*, p. 729), he does not allude to this or any other Cycad as having been observed by him in the course of his excursions in Zanzibar itself. But it is interesting to find (l.c. p. 599), that in an uncultivated valley in the island of Pemba he met with 'Mikindu' plants (*Encephalartos* sp.), much resembling Sago-palms, from the leaves of which fine mats are made." There is no other record of a Cycad in Pemba, and the vernacular name cited has not been recorded elsewhere. There is at least the possibility, however, that 'Mikindu' may prove to be *E. Hildebrandtii* and it is hoped that this note may induce visitors to the island to transmit to Kew the material required to settle the doubt.

With the references to mainland localities in Fitzgerald's work we appear to be on surer ground. In his summary of the notable vegetable productions seen Fitzgerald gives (p. 617) " 'Kitsapu.' a Cycad. The heart of this palm-like tree is cut into dice and subjected to soaking and drying for three days, after which it may be pounded or ground and cooked or baked. Both this and the fruit are resorted to in times of famine. Unless carefully prepared it may cause fatal diarrhoea and vomiting." This practice is given in such detail in connection with the Wa-Giryama; the vernacular name cited is obviously a variant of the term " Mtsapu " used by the Rev. Mr. Taylor for specimens at the British Museum which are *E. Hildebrandtii*. But in a passage contributed by Taylor to Fitzgerald's work there is a reference to this Cycad which indicates that only one species is to be met with in British East Africa and that species, as the various specimens collected by Taylor show, is *E. Hildebrandtii*.

Fitzgerald's own references to this species do not contradict this conclusion. In a locality 14 miles north of Rabai, whence Taylor has sent actual specimens, and therefore about midway between Mombasa and the mouth of the Voi River, Fitzgerald " noticed several Cycads " (l.c. p. 288). Again, somewhat further north, between M'Tondua and Konjora, in 3° 28′ S., 39° 45′ E., by his map, he met with many " wild Cycads " (l.c. p. 282). Still further north, at Mere Shambo on the Sabaki River, inland from Melindi, 3° 10′ S., 40° E., he observed a " Cycad called Makumwa in Swahili " (l.c. p. 89). Finally, in a locality near Dodori, on the mainland opposite to and north of Patta Island, in 1° 55′ S., 41° 1′ E., his attention was called to a large wild Cycad with an enormous pine-apple shaped fruit which the Wa-Boni are said to eat (l.c. p. 425).

If, as is probable, all these references are to *E. Hildebrandtii*, its range extends along the coast of East Africa for at least 350 miles from Dar-es-Salam to beyond the island of Patta.



II.

Microconidia of Botrytis cinerea.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 4] [1918

X.—THE MICROCONIDIA OF BOTRYTIS CINEREA.

STUDIES FROM THE PATHOLOGICAL LABORATORY VII.

WILLIAM B. BRIERLEY.

Introduction.—In 1887 Lindner* observed that the cell contents in old hyphae of *Botrytis cinerea* occasionally contracted away from the cell wall, and subsequently developed either into the adjoining cells or into the surrounding medium, giving rise to flask-shaped sterigmata bearing a chain of minute conidia at their tips. An excellent delineation of this microsporogeny is given in figure 13 of plate vii. of his work.

Klöcker and Schönning† also briefly noted the existence of "*spermaties*," and considered them to be an abnormal spore form.

In 1903 Lorrain Smith‡ described a disease of the gooseberry caused by *Botrytis cinerea*, and remarked that "in the test-tube culture the gelatine was liquefied near the surface. The liquid was filled with spores that had become yeast cells, and were budding out in great numbers."

The same year Beauverie and Guilliermond§ published a detailed account of the cytology of the mycelium of *Botrytis cinerea*. They observed the formation of "*sporidies*" when the fungus was grown in bouillon, peptone, and distilled water. Figures of the microconidia are given, and their formation and structure described as follows:—"These sporidia contain, almost from the first, a large vacuole which nearly fills them, and in which are a large number of metachromatic granules. Glycogen is equally abundant. The cytoplasm forms a delicate parietal layer; the nuclei are difficult to distinguish, lying in the peripheral cytoplasm and appearing as small homogeneous masses. The portion of the filament which gives rise to the sporidia contains an accumulation of metachromatic granules, some of which enter the sporidia through their mother cells. The nuclei are difficult to distinguish during the formation of the sporidia, but

* Lindner, P.: Ber. d. deut. bot. Gesell. v, 1887.

† Klöcker, A., et Schönning, H.: Compt. Rend. du Lab. de Carlsberg. v. 1900.

‡ Lorrain Smith, A.: Journ. Bot. xli. 1903.

§ Beauverie, J. et Guilliermond, A.: Centr. f. Bakt. ii. x. 1903.

(5353.) Wt. 196—794. 1,125. 5/18. J. T. & S., Ltd. G. 14. Sch. 12.

it would appear that only one exists in each sterigma; each of the sporidia also contains a single nucleus, this resulting from the division of the nucleus in the sterigma; the formation of the sporidia appears, therefore, to be identical with that of the conidia of *Penicillium glaucum* described by Dangeard and Guéguen. The mature sporidia each contain a single nucleus, situated at the periphery, and a vacuole occupying the greater part of their volume; one or two metachromatic granules are also to be observed in the peripheral layer of cytoplasm.

"In this medium (distilled water) the osmotic pressure of which is very feeble, many curious morphological phenomena are produced. In many of the filaments the protoplasm contracts to the interior in a chain-like manner, and rapidly forms about itself a new membrane. Often these internal filaments produce sporidia, and then show the most curious and bizarre forms."

In 1905 appeared the voluminous work on *Botrytis cinerea* by Istvanffi*. Microsporogeny only occurred when the fungus was grown in glycerine, and the following characteristic forms were exhibited:—(*a*) a form showing resemblance to a promycelium (type *Sclerotinia*); (*b*) small groups on the sterigmata in the shape of a sickle (faucille); (*c*) large masses of the type gamo-cladocephalo-merizosporica; (*d*) little chains at the tips of filaments.

All the foregoing authors regarded this type of spore production as a very rare and abnormal or bizarre occurrence, and in no case was the germination of the microconidia observed.

In 1908 Brooks† published his "Observations on the Biology of *Botrytis cinerea*," and found that microconidial formation occurred when the fungus was cultivated upon bouillon with 10 per cent. gelatine. He states that in this medium "the growth was comparatively feeble, and during the first three generations only conidiophores bearing microconidia were borne. . . . In the fourth generation of the fungus upon the bouillon medium the growth was more luxuriant and the normal conidiophores were produced. It is not known whether this change in the mode of reproduction was dependent upon some alteration in the conditions of experiment, such as accounts for the different modes of reproduction in some algae, as Klebs has shown. If this were the case the alteration must have been a slight one, for the cultures were kept in a room where the obvious physical factors controlling the growth were the same. It may be that the fungus, having become accustomed during three previous generations to the bouillon medium, was sufficiently invigorated to produce again the normal type of conidiophore."

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* Istvanffi, Gy. de,: Anns. de l'Inst. Centr. Ampel. Roy. Hongr. iii. 1905. It should be noted that throughout the whole of his work Istvanffi regarded *Botrytis cinerea* as identical with *Sclerotinia Fuckeliana*. In view of the very general acceptance of this author's investigations, it cannot be too often emphasised that there is no good evidence to show that these two fungi are other than discrete species, without genetic relationship, and belonging to widely separated groups. See Lind, J.—Danish Fungi in the Herbarium of E. Rostrup, Copenhagen, 1913; Pethybridge, G. H.—Journ. Dept. Agr. Ireland, xi. No. 3, 1911; xvi. No. 4, 1916; Smith, R. E.—Bot. Gaz. xxix. 1900.

† Brooks, F. T.: Ann. Bot. xxii. 1908.

In 1902 Farneti * published a remarkable account of the polymorphism of a new species of Botrytis attacking *Salvia Horminium, L.* His results may be summarised as follows:—The fungus, which the author designates *Botrytis hormini*, gives rise to:—

(i.) a sterile mycelium multiplying by fragmentation and producing the forms ii. v., vi., and vii.
(ii.) the type *Polyactis* which reproduces by conidia.
(iii.) the type *Cristularia* with microconidia, which never reproduce the *Cristularia* form, but the type ii. (*Polyactis*), and the type vii. (*Gamocladocephalo-merizosporica*).
(iv.) the sclerotia.
(v.) a form with conidia of the type *Macrosporium*, which produce similar spores or those of the type vi. (*Alternaria*).
(vi.) a conidial form of the type *Alternaria* which gives rise to similar spores.
(vii.) an abnormal conidial type *Gamocladocephalo-merizosporica* having two kinds of microconidia. The first correspond to those of the form ii. (*Polyactis*) and give rise either to a similar type (*Polyactis*), or to the form vii. (abnormal). The second of the type iii. (*Cristularia*) reproduce a similar type iii. (*Cristularia*) or the type ii. (*Polyactis*).

It is very unfortunate that practically all experimental details are omitted from this account.

This polymorphism is so extreme and of so unusual an order that until some degree of confirmation is forthcoming the author's interpretation of his results must be accepted with much reserve. An examination of the many figures accompanying the memoire makes it appear very probable that types i. (fragmenting sterile mycelium ii. (*Polyactis*), iii. (*Cristularia*), iv. (Sclerotia), vii. (*Gamocladocephalo-merizosporica*), were various phases of the common fungus *Botrytis cinerea*; whilst v. and vi., the *Macrosporium-Alternaria* types, were merely different growth phases of the common contaminating fungus *Macrosporium* sp. The latter supposition receives strong confirmation from the fact that on development these spores never gave the *Botrytis* type, but only, as would be expected, further generations of themselves. If the above hypothesis be correct, Farneti would thus have observed not only the process of microsporogeny in *Botrytis cinerea*, but the germination of these minute spores, this being accurately represented in plate xx. of his work.

Perhaps no single fungus has been so thoroughly investigated by so many competent observers as *Botrytis cinerea*, or is the centre of such an extensive literature; and yet only in the six or probably seven cases already noted has a process of microsporogeny been observed. In the past contaminating fungi have frequently been confused with the real fungus under investigation, and in the present case this admittedly rare, abnormal, or

* Farneti, R.: Atti. del. R. Ist. Bot. d'Univ. di Pavia, vii. 1902.

bizarre type of fructification bears a striking resemblance both in manner of growth and size and shape of spore to the ubiquitous contaminating fungus *Penicillium* sp. In consequence, there is among mycologists a very general scepticism as to the reality of any genetic relationship between the microsporogenating mycelium and *Botrytis cinerea*. Even if the evidence of such relationship be admitted, the microconidia are merely regarded as a bizarre form without morphological status, and are unrecognised in systematic treatises on the fungi.

Whilst carrying out an extensive series of pure culture experiments with this fungus, the formation of microconidia was noted and the opportunity was taken to attempt a decisive settlement of the question of the true status of these spores.

The process of microsporogeny was first observed in a culture six weeks old of a strain of the fungus derived from onion leaves and growing upon potato agar. The presence of an abundant development of a penicillioid type of conidiophore giving rise to immense numbers of minute spores was regarded as a contamination, and the culture was rejected. Three other cultures of the same strain made at the same time, one on a similar medium, and two on potato gelatine were then examined, and found to contain a like contamination in equal abundance. This led to a more careful examination, which revealed the fact that the penicillioid growth was in organic connection with the *Botrytis* mycelium. It was at first suspected that the former was developing parasitically upon the latter, as in the case of *Cicinnobolus* upon the mycelium of *Erysiphe*,* or certain Penicillia upon the fungus *Mucor*,† but a detailed investigation proved conclusively that the formation of minute conidia is a true developmental stage of the fungus *Botrytis cinerea*. Examination of numerous cultures and diseased host plants showed that this stage is not the rare and bizarre occurrence hitherto supposed, but an exceedingly common and probably integral stage in the life history of the fungus *Botrytis cinerea*. A few observations have been made upon the genesis and development of these microconidia and the possible factors controlling their production, and in the complete absence of information concerning the process of microsporogeny in this fungus, these have been considered of sufficient interest to merit a brief presentation.

Formation of Microconidia.

The microconidia may originate either from the vegetative mycelium, from the cells of the conidiophores, or directly by the germination of the conidia. The latter as the simplest case will be described first.

Microconidia arising from normal Polyactis conidia.—Conidia normal in size and appearance germinate by the protusion at one or more points on their surface of a small and delicate germ tube. From its initiation this differs from a normal germ tube in being

* See De Bary in De Bary, A. and Woronin, M.: Beiträge zur Morphologie und Physiologie der Pilze, 1870.

† Brefeld, O.: Untersuchungen ii. 1874.

vacuolate. When a length of 10-15 μ has been attained linear growth usually ceases, a septum may or may not be formed, separating the spore from the hypha, and the latter assumes a bottle or phial shape and functions as a sterigma. The tip of this structure becomes swollen, and finally is cut off as a separate spore (Pl. v. fig. 1), the first of many which later may form long chains or irregular clusters. This type of spore germination bears a striking resemblance to that of the brand spores of species of *Geminella* as described and figured by Brefeld.* The result of germination, however, is often more complex than this, two or more sterigmata arising from a hypha of variable length. Pl. v. fig. 3 shows such a case, the development of which was followed under the microscope. At 7.20 p.m. a short two-celled hypha was in evidence. An hour later the terminal sterigma had almost formed a spore, whilst a second sterigma was arising from the basal cell. By 10 p.m. two spores had been formed by the terminal sterigma which was also giving rise to a new lateral sterigma, and the sterigma from the basal cell had almost completed the formation of a spore. A still more complex form of direct germination is seen in Pl. v. fig. 4, and this may reach at times an extraordinary degree of complexity (Pl. v. fig. 6). Superficially such forms as the latter appear simply as compact masses of spores, and it is only when these are removed that the real morphological structure can be seen. Undoubtedly the *Gamocladocephalo-merizosporica* form of Farneti, as probably also the *Cristularia* form, are merely growths of this character. Occasionally the sterigmata are borne at the extremity of a hypha of some considerable length.—(Pl. v. fig. 5). The latter is slender but possesses a swollen end cell from which arise the sterigmata. Not infrequently a spore germinates, giving rise to a rather slender and sparsely branched mycelium of very limited growth. On these hyphae sterigmata are produced copiously in clusters or singly in terminal and lateral positions. If a fragment of mycelium bearing microconidia be examined in water, the liberated spores tend to aggregate around the large conidia, simulating very closely the active budding of yeast cells. It is probable that the budding of spores described by Lorrain Smith (loc. cit.) was of this nature, for true budding in the absence of a definite sterigmata has neither been noted by other observers nor found during my own work.

The origin of Microconidia from the conidiophores.—The formation of microconidia from the conidiophores presents many features of interest. The spore-bearing hyphae of *Botrytis* are organs of strictly limited growth and highly specialised character. The lower portion is structurally different and behaves differently from the upper region, and it will conduce to clearness if these are treated separately.

Upper region.—The cells of the upper region are thin walled and densely filled with usually homogeneous or finely granular

* Brefeld, O.: Untersuchungen ix. 1891; xv, 1912.

protoplasm which by virtue of its sporogenating function is in a vigorous and plastic condition.

When microconidial formation occurs the spore-bearing branchlets of the conidiophore often proliferate, giving rise to long slender hyphae which either terminate in slightly swollen cells from which arise the sterigmata (Pl. v. fig. 8), or more rarely pass directly into a single sterigma. Not infrequently these hyphae are themselves branched, so that a freely ramifying system is formed, producing an immense number of spores. Single or branched sterigmata often arise laterally on these hyphae.

Frequently the sporogenous branches of the conidiophore do not proliferate, but slender hyphae develop from immediately below them, and these originate the microconidia as already described.

Lower region.—The coloured lower region of the conidiophore consists of thick-walled and mechanically rigid cells containing large vacuoles and very little protoplasm, the latter being disposed as a thin parietal layer. These specialised cells have not the plasticity possessed by those of the upper region and have never been observed to grow out directly into a hyphal system. Microconidial formation may occur in one of two ways. The contents of a cell may pierce the cell wall and give rise on the outside of the hypha to a short but more or less branched structure closely resembling that derived from conidial germination and occasionally reaching a similar degree of complexity (Pl. v. fig. 7). More often, however, one cell of the conidiophore grows into its adjacent cell and there produces microconidia (Pl. v. figs. 9 and 10). Not infrequently several old cells are traversed by the sporogenating hypha before the principal formation of spores occurs, and often the containing cells are ultimately so completely filled by the microconidia that they resemble mature phycomycetous sporangia. The cells of the conidiophore from which the new growths originate, always contain an abundance of vacuolate protoplasm and appear to undergo previously a process of rejuvenescence. Frequently as noted by Lindner and Beauverie and Guilliermond the contents contract away from the walls and surround themselves with a new membrane, in which case they may be regarded as "aplanospores" which on germination give rise to microconidia. Often this contraction does not occur, but in all cases there is an apparent renewal of vigour and a marked increase in the quantity of cell content.

Microconidia arising from the vegetative mycelium.—Any portion of the vegetative mycelium may give rise to sterigmata borne either directly, or on special hyphae of a greater or less degree of complexity. Not infrequently this is preceded by a process of rejuvenescence, and the formation of a new membrane about the cell contents, but usually the cell contents simply grow out as in the formation of a lateral branch. The sterigmata may be formed at the swollen tip of a slender branch of varying length, or may occur in little clusters along the parent hypha, or as single sterigmata in either a lateral or terminal position. Identical appearances have been described in the mycelium of various species of

*Geminella** and *Sclerotinia*† and are known in certain other fungi. When large clusters of sterigmata occur in close proximity they produce the *Gamocladocephalo-merizosporica* and *Cristularia* forms of Farneti. Not infrequently the rejuvenescent cells germinate into adjacent cells and give rise to large numbers of microconidia as described for the conidiophores (Pl. v. figs. 9 and 10). Occasionally where a hypha is slender the spores form a single chain along the lumen, simulating the appearance of endoconidia (Pl. v. fig. 8). In all cases, however, microsporogeny takes place by a process of acropetal segmentation from a specialised sterigma and never by fragmentation‡ or budding.

Formation of microconidia.—The exact details of the process of microsporogeny may easily be determined either by observation of the several stages as shown by different sterigmata, or by following the actual development in any single case. The sterigma becomes swollen at the tip, the cell membrane thinning out very distinctly in the neck region (Pl. v. fig. 11 f) so that the spherical extremity which is surrounded by an extremely thin pellicle appears to be affixed to the end of the tapering sterigma. The thinning of the wall commences abruptly, and just at this point in the neck a transverse septum is formed, separating the spore from the sterigma (Pl. v. fig. 11 g). This septum splits along its middle lamella liberating the spore. The succeeding spore arises by the pushing out of the thin pellicle, closing the extreme tip of the sterigma (Pl. v. fig. 11 h) by the turgid protoplasmic contents, the abrupt ending of the walled region of the sterigma showing as a line across the neck (Pl. v. fig. 11). The swelling increases, is separated as before by a septum which splits in the plane of the middle lamella freeing the second spore (Pl. v. fig. 11 h, a, b, c, d, e). This process is continued so that ultimately a long chain or cluster of spores is formed on each sterigma, the new spores pushing before them those previously formed. Each spore is connected with those succeeding it by a short neck which represents the part finally cut off from the sterigma, so that although most usually it appears spherical, it is in reality slightly pear-shaped.

The microconidia are 2-3 μ in diameter, surrounded by an exceedingly thin pellicle, and contain one, or infrequently more than one, central and highly refractive granule of an amorphous

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* Brefeld O.: loc. cit.

† Brefeld, O.: Untersuchungen iv. 1881, ix. 1891, and the recent figures of Gilbert, A. H., and Bennett, C. W.: Phytopathology vii. 1917.

‡ Under certain conditions mycelial fragmentation may occur, but the large 'oidia' so formed are utterly different from the microconidia. Beauverie and Guilliermond conclude that fragmentation is conditioned by a temperature factor, but in my experiments I have been able very frequently to produce this condition in a period of two or three days by placing vigorous mycelium in distilled water, thus indicating that the oidial state is a direct response to a condition of physiological starvation. The oidia are short-lived and germinate under favourable conditions giving rise to the normal vegetative mycelium, and their production appears to be a method of tiding the fungus over a suddenly arising adverse period. Fragmentation has also been recorded by Berlese (Malphighia 1889), Farneti and Istvanffi.

consistency. This is described by Beauverie and Guilliermond as a vacuole, but it differs widely both in appearance and behaviour from the other vacuoles present in the cytoplasm. The granule is soluble in hot water but not in alcohol, ether, or chloroform. No clear reaction is obtained with Fehling's solution, Schultze's solution, or Millon's reagent. A solution of iodine in potassium iodide stains it yellow and it is coloured deeply by methylene blue. The granule would therefore appear to bear close relation to the volutin substance described by Meyer* in the bacteria, and in the yeasts by Wager and Peniston.† The behaviour of the granule on the germination of the spore supports the view that it is a reserve stuff and not a vacuole. The cytoplasm of the spore contains abundant glycogen and a single nucleus which is not easy to distinguish. The sterigmata are also uninucleate and contain glycogen.

Germination of the Microconidia.

On germination which occurs in from twenty-four to forty-eight hours after immersion in water or a nutrient medium at a temperature of 17° C. to 23° C. the spore increases markedly in size and either protrudes a slender germ-tube or itself elongates into a minute hypha. The volutin granule disintegrates into smaller particles which become scattered through the young hypha and finally disappear. In water the growth is very scanty and quickly dies away, but in nutrient media the germ-tubes become vigorous and give rise to a normal mycelium which in the course of a few days bears *Polyactis* conidiophores. If the *Gamocladocephalo-merizosporica* stage and the *Cristularia* stage of Farneti represent, as would appear highly probable, the microconidial stage of *Botrytis cinerea*, then according to this author a certain proportion of these spores should give rise to a mycelium bearing only microconidia (the *Cristularia* type). Brooks found in his cultures on bouillon that the first three generations were purely microconidial, whilst the fourth generation under apparently identical conditions was of the usual *Polyactis* type.

In order to settle with certainty the fate of the microconidia, a number of hanging drops were made containing only these spores. They were prepared by making successive dilutions of spore mixtures derived from cultures of distinct and recognisable strains. As the microconidia were present in immense numbers, they were obtained practically pure in final dilutions. Drops were then prepared from the latter, and several were thus obtained containing only microspores. The germination of these spores was followed, and the absence of *Polyactis* conidia most carefully ascertained. The outer surfaces of the cover slips were then sterilised in mercuric bichloride solution, thoroughly washed with distilled water, and the cover slips dropped into tubes of nutrient media. Eight such tubes were prepared, four of potato agar, and four of potato gelatine, two of each being incubated at 22° C.—23° C., whilst the others remained in the diffuse light of the laboratory at a temperature of 15° C.—17° C. One of the

* Meyer, A.: Die Zelle der Bakterien, Jena, 1912.

† Wager, H. H., and Peniston, A.: Ann. Bot. xxiv, 1910.

latter tubes remained sterile whilst after three days the remaining seven gave rise to pure cultures of *Botrytis cinerea* corresponding to the strains from which the original spores had been obtained. The conidia and conidiophores were of the usual *Polyactis* type. In due course these cultures gave rise to microconidia.

Successful infections of living tissues were obtained by placing drop dilutions containing only microconidia on wounded surfaces. These experiments were carried out in test-tubes and under rigidly sterile conditions, the hosts inoculated being fleshy leaves of *Crassula* sp. and sugar beet root. The invading hyphae at first grew slowly but later with greater rapidity, and *Polyactis* fructifications were formed in from ten to fifteen days. With one exception the control plants remained perfectly healthy. Inoculations of unwounded surfaces were a total failure. Nothing resembling the polymorphism described by Farneti nor the dimorphism obtained by Brooks was noted at this, or any other stage, of the investigation. The microconidia appear to be merely a normal developmental stage in the life cycle of *Botrytis cinerea*, which on germination give rise to vegetative mycelium, producing in course of time the *Polyactis* type of fructification.

Conditions of Microconidial Formation.

In 1896, Klebs* demonstrated that the developmental stages in the life-history of the algae and fungi are determined by specific quantitative changes in the conditions of life of the organisms. It seemed desirable therefore in the present case to ascertain if possible the nature of the factor or factors which stimulate *Botrytis cinerea* to the formation of microconidia. The conditions primarily affecting the reproductive processes in the fungi are those of atmospheric humidity, light, temperature, nutrition, and age, and the influence of these factors on the formation of spores in *Botrytis* may be briefly discussed.

Atmospheric humidity.—A certain degree of atmospheric humidity is essential to the aerial growth of any fungus. If *Botrytis* be grown on a medium in an atmosphere dried to a certain degree by calcium chloride the conidiophores are small, weak and stunted, and few spores are formed, but neither the general character nor the size of the mature spore is affected. At normal laboratory temperatures a saturated atmosphere induces a luxuriant fruiting growth. At higher temperatures, however, (above 25° C.), atmospheric saturation tends to induce proliferation of the sporogenous heads of the conidiophores so that an almost or even completely sterile condition may be brought about. The sterile form obtained by Beauverie and Guilliermond was probably the result of a high temperature acting in conjunction with a saturated atmosphere, but the atmospheric humidity, and not the temperature, was the primary factor involved. These authors found the sterility to become permanent, but this has not

* Klebs, G.: Die Bedingung der Fortpflanzung bei Algen und Pilzen. Jena, 1896; also Jahr. f. wiss. Bot. 1898 and 1900; Probleme der Entwickelung iii. Biol. Centralb. 1904.

been confirmed in my own work, the mycelium freely producing conidia when again transferred to a more normal environment. As microconidial formation has occurred copiously on media subjected to many different degrees of atmospheric humidity, it is improbable that this factor bears any relation to the particular type of sporogeny under consideration.

Light.—It has been repeatedly stated in mycological literature that the conidia of *Botrytis* are only formed in darkness, but this may easily be refuted by exposing cultures of the fungus to continuous lighting. The formation of conidia is not inhibited but merely retarded, and a series of spore comparisons shows that there is no difference of size in the conidia formed under the two conditions. Exposure to very intense light is inimical to mycelial development, and the fungus grows feebly downward into the substratum. If, however, the intensity of light be decreased development is more vigorous and conidia are produced which in size and shape are indistinguishable from those developed by similar cultures in diffuse light or in darkness. Cultures in which microconidial formation has occurred abundantly have been maintained either in the diffuse light of the laboratory, or in the darkness of an incubator. Varying intensity of light therefore does not affect the size of the conidia nor the type of sporogeny, but only the amount and rapidity of conidial formation. The same holds true of light of different wave lengths. Exposure to the less refrangible rays of the spectrum inhibits the formation of conidia, whilst these are produced in abundance in blue or violet light. The quality of sporogeny, however, is not affected, but only the quantity; either *Polyactis* conidia are produced or there is sterility*. Light cannot therefore be the determining factor in the production of microconidia.

Temperature.—Spore formation in *Botrytis cinerea* is greatly and directly influenced by the temperature at which the fungus develops. In a series of researches Beauverie and Guilliermond† have shown that this fungus which at ordinary temperatures reproduces in the normal *Polyactis* manner, passes into a semi-sterile form with proliferating conidiophores "forme intermédiare" when grown at a temperature of 25° C and into a completely sterile mycelium at a temperature of 30° C. to 35° C. I am not able to confirm the results of these authors in the strains of *Botrytis cinerea* with which I have worked. On the majority of vegetable media the fungus produces spores very abundantly between the temperatures of 16° C. and 25° C. With raised or lowered temperature mycelial growth and spore production is reduced, the latter ceasing at about 5° C. and 33° C. and the former possessing a slightly greater range. With vary-

* See Costantin, J.: Bull. Soc. bot. de Fr. 1889; Klein, L.: Bot. Zeit. 1885; Reidemeister, W.: Ann. Mycol. vii. 1909; Moreau, M. and F.: Bull. Soc. bot. de Fr. 1913.

† Beauverie, J.: Compt. Rend. 128, 1899, and 133, 1901, also Anns. Univ. Lyon. Nouv. sér. iii. Beauverie, J., and Guilliermond; Centr. f. Bakt. ii. x. 1903.

ing temperature there is no change in the size or shape of conidia. Cultures which have produced microconidia in profusion have been kept either at the laboratory temperature of 15° C. to 17° C. or in an incubator at 22° C. to 23° C.

The factor of temperature, therefore, like those of light and humidity is not the determining condition in the formation of microconidia.

Nutrition.—The factor of nutrition is much more complex than the three factors which have been briefly commented upon. Many distinct influences are comprised, such for example as the physiological availability of the nutritive substance and its accessibility to the fungus, the dilution or concentration of the food, and the effect of the presence of other chemical substances and accessory food bodies. Failure to distinguish between these component factors renders invalid the results obtained in perhaps the majority of investigations on the nutrition of fungi.

The substrata on which microsporogeny has occurred in the present work include the following:—Potato agar, potato gelatine, parsnip agar, parsnip gelatine, Quaker oat agar, Quaker oat gelatine, steamed slants of tuber of potato and artichoke; roots of red beet, sugar beet, carrot, turnip, and swede; fruits of quince, apple and pear; and onion bulb. Experimental inoculations into the following living hosts have given microconidia:—Bulbs of daffodil, and onion; fruits of apple, pear, quince, and tomato; roots of red beet, sugar beet, carrot, swede, and turnip; and tubers of potato and artichoke. Microsporogeny has been observed on the following naturally infected hosts:—Bulbs of onion and hyacinth, fruits of apple, tomato, and quince, leaves of cabbage, crassula, cotyledon, clematis, geranium, and other herbaceous plants, and roots of carrot. It may also conveniently be noted here that strains of *Botrytis* derived from the following original hosts have produced microconidia in culture and on other living hosts:—Fruits of apple, quince, and tomato, roots of carrot, bulbs of onion, leaves of cabbage, lettuce, and primula, shoots and "fruits" of fig trees, and the stem of an *Aesculus Pavia* which had been killed by the fungus.* Previous authors have found microconidia upon peptone, distilled water, bouillon and glycerine.

This type of spore production has been regarded as an abnormal or bizarre form consequent upon development in a physiologically unsuitable medium. Bizarre structures are very common in all groups of plants, and many have been recorded among the fungi,† but in the present instance this hypothesis is very improbable, for, as noted above, microconidia occur regularly on all kinds of media and natural hosts under perfectly normal conditions, and possess a well-defined place in the life-cycle of the fungus. Furthermore if this type of sporogeny is a degenerate or diseased structure due to physiological starvation, there should be found

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* Since this paper was written microconidia have been found in strains of the fungus derived from thirty additional hosts, and have incurred in culture on all the media and natural substrata used.

† See Worsdell, W. C.: Principles of Plant Teratology, London, 1915.

a gradual transition between the usual *Polyactis* form upon a suitable medium, and the microconidial form upon an unsuitable medium; and it should be possible to obtain every stage in this transition by growing the fungus upon a carefully graduated series of media. Experiments have shown that this is not the case. Microsporogeny occurs for instance equally when the fungus is growing vigorously upon the natural hosts, and when it is struggling to grow in a medium physiologically unsuitable to its needs. Moreover, the formation of microconidia of constant size by sterigmata of very specialised type upon a penicillioid form of conidiophore is a development perfectly distinct and abruptly separated from the *Polyactis* fructification: there are no transitional forms of either spore or conidiophore.

Numerous studies have been made* on the effect of various food conditions upon spore formation in *Botrytis cinerea*, and it has been clearly demonstrated that nutritional factors merely cause either an increase or decrease in the amount of conidial production, or accelerate or retard the formation of spores. Physiological starvation like physiological repletion controls the quantity and not the quality of conidial formation,† and cannot, therefore, be the determining factor in microsporogeny.

Age.—There remains to discuss the factor of age, and this in the author's view, is the primary factor determining the production of microconidia. It seemed advisable to eliminate the other factors before proceeding to this, and here it will be well to present the positive evidence before discussing it.

In a vigorous culture of *Botrytis* upon an artificial medium under normal conditions of temperature, light, and atmospheric humidity, the first generation of conidia is formed in from two to three days. These largely fall to the surface of the medium, germinate and produce a second generation of spores, which give rise to a third by a similar process. After, perhaps, three to five such generations, the available germinating surface of the medium has been completely occupied and comparatively little further germination or conidial production occurs. It follows, therefore, that in a vigorous culture a month old, the majority of the conidia and the greater part of the conidiophores and vegetative mycelium, are from two to three weeks of age, and in a two months culture their age is approximately six to seven weeks. In a medium with a considerable surface extent the age of the conidiophores is also conditioned by their distance from the original point of infection.

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* See in particular Behrens, J.: Centrl. f. Bakt. ii. iv. 1898; Smith, R. E.: Bot. Gaz. xxxiii. 1902; Istvanffi, Gyde: (loc. cit.); Benecke. W., in Lafar's Hand. Tech. Mykol i. 1904–1907; Reidemeister, W.: (loc. cit.); and Peltier, G. L.: Anns. Mo. Bot. Gard. xxiii, 1912.

† See, however, the note on mycelial fragmentation. Also, vigorous hyphæ which are suddenly starved by being placed in a physiologically unavailable medium or by drought rapidly form chlamydospores. This is a very common spore-form of *Botrytis*, but has been rarely noted in mycological literature, see Price, S. R.: New Phyt. x, 1911; Istvanffi (loc. cit.) On germination, these chlamydospores which are thick-walled and resistant give rise to the normal mycelium, and like the oidia already described, serve to tide the fungus over a period of adverse conditions.

Now with a few exceptions the process of microsporogeny has not been found in cultures less than one month old; and this holds true of living hosts which have been experimentally inoculated with the fungus, and, so far as can be judged, of hosts naturally infected, although the latter obviously cannot be included with the same degree of certainty.

If freshly formed conidia be placed under favourable conditions in a nutrient medium, such as a hanging drop of potato agar or gelatine, approximately one hundred per cent. of the spores germinate, giving rise to normal vegetative mycelium. If conidia from a similar culture one month old be treated in a like manner a variable proportion of the spores are found to be incapable of germination, about three-quarters of the remainder germinate by the protrusion of a germ-tube, whilst the others give rise to microconidia. If this experiment be repeated with spores from a culture two months of age, considerably more than one half of the spores do not germinate; and of the remainder many more give rise to microconidia or hyphae of limited growth bearing sterigmata than produce germ tubes originating the usual vegetative mycelium; and with increasing age this disparity becomes more pronounced. It might be criticised that the latter does not result from age but from physiological starvation due to exhaustion of the original medium or to the presence of toxic excreta. In perhaps the majority of cases, however, this medium is obviously not exhausted and in any case it is difficult to understand why this should affect spores germinating in a fresh and exceedingly favourable nutrient solution.*

Evidence pointing in the same direction is presented by the formation of microconidia by the vegetative hyphae and the conidiophores, for, as Lindner noted, only old mycelium shows this type of sporogeny. What has been described of cultures of the fungus upon artificial or natural media is equally true of the *Botrytis* developing in nature upon the living host.

The facts stated above are most easily and naturally interpretable by the hypothesis that microsporogeny is a normal and discrete developmental phase in the life cycle of *Botrytis cinerea*, and that it is controlled primarily by an age factor. If this hypothesis be correct it is desirable that some explanation be forthcoming of the fact that the great majority of mycologists who have investigated this ubiquitous fungus have overlooked this stage in its life history; whilst the few who have recorded it have found it in cultures of an age considerably less than that indicated here as approximately the normal controlling factor.

I conceive these explanations to be as follow:—The plants attacked by *Botrytis* are in nearly all cases of a soft herbaceous nature, and owing to the enzymic action of the fungus, are very

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* Since the paper went to press very many more strains of *Botrytis cinerea* have been examined, and it has been found that the above paragraph, although presenting a true general picture, is not true in all cases. The production of microconidia by direct germination of the *Polyactis* spores appears to be very largely a strain character; certain strains microsporogenating chiefly in this way, whilst others produce these minute spores principally from the old mycelium.

quickly reduced to a semi-fluid or pulpy condition. This rapid disintegration is accelerated by innumerable saprophytic fungi and bacteria, so that by the time the age factor should come into operation the host plant has either completely disappeared, or exists in such a condition that few mycologists care to retain it as an object of close observation. If on the contrary the host shrivels and dries to a mummified condition, the desiccation of the medium usually inhibits all growth, and consequently also the process of microsporogeny. Should the host plant, however, remain in such a state that it forms a suitable pabulum, it becomes so completely permeated by innumerable saprophytic organisms, that one minute type of penicillioid conidiophore more or less is easily overlooked in the general gamut of fungal fructifications.

Again in cultures of the fungus on artificial media microsporogeny does not often occur within a period of approximately one month. If germination studies are carried out the spores are always taken from young cultures and in consequence produce normal germ tubes giving rise to the usual mycelium. Cultures of an age in which microsporogeny is occurring are seldom examined and rarely used except as stock cultures for the purpose of keeping alive a particular strain. When sub-cultures are made from these the microconidia germinate and give rise to a normal mycelium producing the usual conidiophores, so that the microconidial origin of the new culture remains unsuspected. If by chance the microconidial type of fructification is observed in cultures it is regarded, as in the author's own experience, as one of the many penicillioid fungi so commonly occurring as contaminations, and the cultures are rejected as impure. Furthermore the microconidia themselves are of so extremely delicate and evanescent a nature, that in growths which have passed through the microsporogenating period, their collapsed and shrivelled remains are almost impossible to distinguish amid the general detritus of an old culture. These reasons appear to the author sufficiently adequate to explain the omission of any record of the process of microsporogeny in many previous accounts of this fungus.

The occurrence of microconidial formation in young cultures is equally susceptible of explanation. The records may be briefly commented upon. Lindner and Klöcker and Schönning merely note the presence of microconidia and beyond stating that they are formed on old mycelia do not give any detailed information regarding the conditions of their occurrence. Beauverie and Guilliermond, however, relate a number of interesting facts concerning their formation. In bouillon the fungus developed vigorously first producing sporidia and later *Polyactis* fructifications. In peptone an abundant formation of microconidia was noted, but further details are omitted. In distilled water the scanty growth showed all the symptoms of starvation and produced few sporidia and no *Polyactis* conidiophores. Thus microsporogeny occurred prior to the *Polyactis* type of sporogeny and in both vigorous and starved growths. It would appear, therefore, that in these cultures microconidial formation was not

related to physiological starvation or any direct nutritional condition; but to some accessory factor.

Istvanffii obtained microconidia by germinating conidia in dilute solutions of glycerine (1 per cent., 5 per cent., 10 per cent.). The mycelial development was sparse, but microconidia occurred profusely, the sterigmata being borne often on highly abnormal hyphae. The author remarks: " In these old cultures (two or three weeks) we have found the best sterigmatous formations." Although Istvanffi carried out a very great number of germination experiments with the spores of this fungus using a large number of different media, many of an obviously physiologically unsuitable nature, only in this particular case was microsporogeny noted, and it would appear improbable therefore that the abnormal sporogenous process was related to the food value of the medium, but again rather to some accessory (possibly chemical) factor. Moreover, it does not seem highly improbable that in this particular case Istvanffi may have chanced to use spores from an old culture when, as has been shown, they would normally germinate in the manner described by the author.

Lorrain Smith found " spores that had become yeast cells " in a culture on gelatine but does not indicate the age of this culture, or state whether a yeast contamination was present.

Brooks grew the fungus upon bouillon with 10 per cent. gelatine. He remarks " the growth was comparatively feeble, and during the first three generations only conidiophores bearing microconidia were borne. In the fourth generation of the fungus upon the bouillon medium the growth was more luxuriant and the normal conidiophores were produced. The cultures were kept in a room where the obvious physical factors controlling the growth were the same." This result is difficult to reconcile with that obtained by Beauverie and Guilliermond and it is not easy to understand why, on the author's assumption that microsporogeny was due to physiological starvation, a strain which was gradually gaining strength should suddenly change the quality of its spore formation at a single bound and only in the fourth generation. One would rather expect it to follow the course found by the French authors and form microconidia at first and later in the same medium *gradually* change the quality of its spore formation. Furthermore it has been pointed out that physiological starvation does not induce the process of microsporogeny and in the present case the complete microsporogeny followed by the abrupt change is much more indicative of some, probably chemical, difference in the media which in the first three cultures interfered with the normal controlling factors.

Among my own cultures premature microsporogeny has occurred in the following cases, always, however, being preceded by the normal production of *Polyactis* conidia. A strain from onion bulb growing on steamed carrot formed microconidia after fourteen days; a strain from *Antirrhinum* on potato agar after eleven days, and a similar culture after fourteen days. A strain from lettuce growing on living sugar beet root showed microsporogeny after thirteen days. In each of these cases the culture was vigorous and microconidial production at first very

scanty. In exactly similar cultures of the same date growing under identical conditions microsporogeny only occurred after about four weeks' time, and the premature sporogeny is most easily explained by assuming that this fungal character, like all other characters, is variable. On this view the time factor in a large series of cultures would find expression in a normal curve of frequency, the mode being perhaps about five weeks. This, however, would not apply to the results of previous authors in which the whole life cycle is disturbed and certain developmental stages reversed or omitted.

This résumé of the recorded cases of premature microsporogeny shows that the results are very discordant, and apart from some accessory and possibly chemical factor, exhibit no evident common condition which could function as the determining factor in the formation of microconidia. Again it may be pointed out that the results obtained by these authors do not coincide with each other or with those either of myself or of other investigators* and it would appear that in these abnormal cases the usual life cycle of *Botrytis*†—mycelium—*Polyactis* stage—microconidial stage—(with a sclerotial stage according to nutritional conditions) has been drastically interfered with and the spore stages reversed, or even eliminated.

This abnormality of life cycle is by no means a rare occurrence in the vegetable kingdom. Perhaps one of the most striking cases is that described by Möbius‡ of the oak in which almost the whole vegetative life was eliminated. Flowering seedlings of one to three years old were observed, whereas normally the tree does not flower until it is sixty or eighty years of age. In many cases the factors which control the cycle of life phenomena are known, and it is, for example, a well-known horticultural practice to reverse the sequence of flowers and leaves or eliminate certain developmental stages in many bulbous plants and ornamental shrubs by subjecting them to specific quantitative changes of environment, such as temperature and humidity.§ In the case of the fungi this control has almost become a common laboratory technique. Thus Klebs has shown that "by modifying the external conditions it is possible to induce fungi to grow continuously for several years or, in the course of a few days, to die after an enormous production of sexual or asexual cells. In some instances even an almost complete stoppage of growth may be caused, reproductive cells being scarcely formed before the organism is again compelled to resort to reproduction. Thus the sequence of the different stages in development can be modified as we may desire."

The reproductive stages in the life cycle of *Botrytis* synchronise with crests in the rhythmic working of the metabolic changes in the protoplasm. When these changes proceed harmoniously, the

* See for example, Behrens; Smith, R. E.; Istvanffi; Reidemeister; Peltier; (loc. cit.).

† There is no good evidence for the connection of *Botrytis cinerea* with *Sclerotinia* sp.

‡ Möbius: Beiträge zur Lehre von der Fortpflanzung, Jena, 1897.

§ See Molisch, H.: Das Warmbad, Jena, 1909.

protoplasm of the fungus attains a certain physiological state which is expressed in the formation of *Polyactis* conidia. This initiates a new protoplasmic rhythm the crest of which is represented by the microsporogenating process, and so to the other developmental phases of the organism. Under given conditions the fungus requires certain periods of time to attain to these physiological equilibria, and these times represent the "physiological age" of the fungus at particular reproductive stages.

In the case of *Botrytis cinerea* the normal physiological age at which conidial formation takes place is represented by a few days, and the physiological age at which microsporogeny occurs is about one month; but in the cases under discussion, certain quantitative alterations in the external conditions would appear so to have stimulated the rhythmic working of the fungus protoplasm that the whole life sequence is disorganised, the *Polyactis* stage is eliminated and the physiological age at which microsporogeny occurs is represented in time by a few days. Put briefly, the fungus has, in a few days, attained to a physiological condition which is usually only reached after a period of about four weeks.

This appears to be a phenomenon of the same order as, for example, the elimination of the resting period of the ascospores of *Onygena equina*. In this case the normal physiological age at which germination occurs is represented in time by a period of several months, but by specifically altering the external conditions and here the interfering factor is of a chemical nature* the life processes are so accelerated that this same physiological age may be reached in the course of a few days.

It has been shown that in the case of *Botrytis* the factor primarily controlling microsporogeny is apparently one of age, and it would appear highly probable that in the recorded instances of premature microconidial formation consequent upon the reversal or elimination of certain life processes, the normal controlling factor has been modified by the action of some abnormal or interfering factor present in the medium. Both meat bouillon and the earlier peptone media are of very inconstant and little known chemical composition, and these, like such an abnormal medium as glycerine, might well contain an accessory chemical substance which would throw out of gear the normal life cycle of *Botrytis cinerea*, or, in the words of Klebs, function as a "releasing stimulus" for microsporogeny.

The conclusion therefore at which one arrives is that the formation of microconidia is a normal and discrete stage in the life cycle of *Botrytis cinerea*. It succeeds the *Polyactis* type of fructification and other conditions being normal, does not usually occur until the fungus is about one month old.

The importance of this process in the life-history of the fungus is that it provides a means whereby the organism, when under conditions unfavourable for dissemination and growth, may produce immense numbers of a type of spore so delicate and light

* See Ward, H. M.: Phil. Trans. Roy. Soc. Lond. B. 191, 1899, and Brierley, W. B.: Ann. Bot. xxxi. 1917.

that its rapid spread is certain, and in consequence the continuity of existence of the fungus is ensured.

I have received much assistance in the preparation of cultures and slides from Miss M. N. Owen, Temporary Technical Assistant in the laboratory, and I am glad of this opportunity to record my indebtedness to her.

Explanation of Plate v.

The figures were drawn with the aid of a Zeiss camera lucida. A Swift $\frac{1}{8}$ objective N.A. 0·62 and a III eyepiece were used for figures 1—4 and 9; a Swift $\frac{1}{6}$ objective N.A. 0·85 and a III eyepiece for figures 5, 6, 7, 8, and 10, and a Leitz oil immersion $\frac{1}{12}$ objective N.A. 1·30 with compensating ocular 12 for figures 11 and 12.

Figs. 1—6.—Normal conidia of a strain of *Botrytis* from Primula leaves germinating directly to form microconidia. The simplest form is shown in 2 a where the sterigma is not cut off from the spore. In 1 this septation has occurred, whilst in 2 b the sterigma is formed on a basal cell. In 3 is shown the actual development of the spore as noted at the stated times. The spore contents become progressively more vacuolate. In 4 is seen a more complicated type of germination and in 5 and 6 two extreme types.

Fig. 7.—A cell from the lower portion of a normal conidiophore which has increased its cell contents, pierced the cell membrane, and formed on the outside a " bunching " growth of the type noted in 6.

Fig. 8.—The extreme tip of one of the filaments arising by the proliferation of the sporogenous branches of a normal conidiophore. The terminal cell is swollen and gives rise to sterigmata. Within the filament is a sterigma which is producing microconidia forming a single chain along the lumen. Below these are seen two cells with irregularly thickened walls, which function as chlamydospores.

Fig. 9.—A rejuvenated cell which has protruded through the pore in the transverse wall and formed a single sterigma producing spores, within the filament. a and b show the development in a period of eleven hours.

Fig. 10.—A more complicated and usual case of the formation seen in 9.

Fig. 11.—Various stages in the formation of microconidia. a to e and f to h form two separate series which were followed under the microscope and the figures drawn at the stated times. a to e were very clearly marked by reason of the unusual thickening in the neck-membrane but f to h is the more normal appearance, the wall tapering evenly and ending abruptly.

Fig. 12.—Stages in the germination of the microconidia, a to e representing a single series drawn at the stated times. The enlargement of the spore and the disintegration of the volutin granule are clearly seen. f, g, h, k, are stages in the development of other spores.

XI.—TAXOTROPHIS AND BALANOSTREBLUS.

J. Hutchinson.

The genus *Taxotrophis* (*Urticaceae*) was established by Blume in 1852, and included two species, a Javan plant, *T. javanica*, which he had previously described as *Urtica spinosa*, and *T. Roxburghii*, founded on *Trophis spinosa*, Roxb. In 1873, Bureau* based a new genus, *Phyllochlamys*, on *T. Roxburghii*. In 1861, Thwaites added *T. zeylanica*, founded on *Epicarpurus zeylanica*, Thw., and in 1886 and 1913 Vidal and Elmer respectively described two species from the Philippines, *T. ilicifolia* and *T. obtusa*. In 1900 Boerlage added *T. macrophylla*, founded on *Streblus macrophyllus*, Blume, from the Celebes. Mr. Gamble described in the *Kew Bulletin*, 1913, *T. triapiculata* from specimens collected in Burma by Mr. W. A. Robertson, and one from Cochin-China gathered by Pierre.

Balanostreblus was described and figured by Kurz in 1873. He quotes specimens under his *B. ilicifolia* from Chittagong (*Hooker & Thomson*, No. 4), and from Ava, Burma (*J. Anderson*). Through the kindness of Major Gage, it has been possible to examine the material preserved in the Calcutta Herbarium. It consists of the Chittagong specimen (of which there is more ample material at Kew), and of a plant marked as being "cultivated in the Botanic Garden." It seems probable that this second specimen, which is female, was grown either from seed or was a living plant collected at Ava by Anderson, for there seems to be no wild specimen preserved from that locality, Anderson's at Kew being from Bhamo, about 180 miles to the north-east. And as there is no doubt that this female cultivated specimen is the one figured and described by Kurz, it must be regarded as the type of the genus *Balanostreblus*. A sketch of this plant is given in the accompanying figure. Hooker & Thomson's Chittagong specimen is male, and is undoubtedly *Taxotrophis triapiculata*, Gamble, which again is not distinguishable from *T. ilicifolia*, Vidal, a determination with which Mr. Gamble is entirely in agreement. It is true that extreme forms of the species with entire or coarsely dentate leaves look very different, the dentate one apparently being prevalent in Burma and the Malay Peninsula, and the entire one in the Philippines. But Mr. E. D. Merrill, who in a letter to the Director first called attention to the similarity of *Balanostreblus* and *Taxotrophis*, informs us that "*T. ilicifolia*, Vidal, in the Philippines is enormously variable in its vegetative characters, the leaves varying from the pronounced 'Ilex' type, i.e., spiny-toothed, to quite entire." This variation is indicated in the text figures below. Mr. Merrill has come to the conclusion that the plant "Ulet" figured by Rumphius, Herb. Amb. iii. p. 62, t. 34, is *Taxotrophis ilicifolia*, Vidal. In this he is undoubtedly right. Whether *B. obtusa*, Elmer (see leaf, Fig. 4), should also be regarded as a form of *B. ilicifolia*, I can scarcely judge from the single specimen at Kew. The entire leaves of *B. ilicifolia*

* Bureau in DC. Prodr. xvii, 217 (1873).

(Fig. 5) are nearly always rather elongate oblong-lanceolate and not ovate-elliptic as in *B. obtusa*. It is a point that can best be settled in the field by Philippine botanists.

In the General Plantarum, *Taxotrophis* is included in the tribe *Moreae*, in which the anthers are inflexed in bud, whilst *Balanostreblus* is placed in the *Artocarpeae*, where the anthers are erect. Now it is proved that male flowers of *Balanostreblus* are unknown, its position is very doubtful, and it should probably be removed from the *Artocarpeae* to the *Moraceae*, sub-tribe *Broussonetieae*, near *Malaisia*, an affinity indirectly indicated by Kurz in the Forest Flora of Burma.

Clavis specierum.

Taxotrophis, *Blume*.

Flores foeminei longe pedicellati:—

Flores masculi pedicellati:—

Folia ad basin subcordatum rotundata, oblongo-elliptica, remote undulato-denticulata; flores ♀ solitarii ... ... 1. *javanica*.

Folia ad basin obtusum cuneata, rhomboideo-elliptica, superne plerumque serrato-dentata; flores ♀ plerumque in racemos 3-flores dispositi ... ... 2. *zeylanica*.

Flores masculi sessiles; folia elongato-ovata vel oblongo-elliptica, caudato-acuminata 3. *caudata*.

Fig. 1.—Leaves of *Taxotrophis*; the numbers correspond with those in the text.

Flores foeminei sessiles vel subsessiles:—

Inflorescentia ♂ sessilis, crassa et densiflora:—

Folia apice mucronulato-rotundata, integra, elliptico-ovata ... ... 4. *obtusa.*

Folia acuminata, grosse repando-dentata vel integra et oblongo-elliptica vel oblongo-lanceolata ... ... 5. *ilicifolia.*

Inflorescentia ♂ pedunculata, anguste cylindrica et elongata vel laxiflora:—

Folia acute spinoso-dentata, 4-7 cm. longa, apice bi- vel tri-apiculata; inflorescentia ♂ laxiflora, circiter 2 cm. longa ...

Folia obtuse crenato-serrata, 10-15 cm. longa, longe caudato-acuminata, apice integra; inflorescentia ♂ circiter 4 cm. longa ... ... 7. *Balansae.*

1. **T. javanica,** *Blume,* Mus. Bot. Lugd.-Bat. ii. 77, t. 26 (1852); Miq. Fl. Ind. Bat. i. ii. 279 (1859), excl. syn.; Boerl. Hand. Fl. Ned. Ind. iii. 359 (1900), Koord. et Val. Bijdr. Booms. Java, xi. 4 (1906) excl. syn.; Koord. Exkurs.-Fl. Java. ii. 88, fig. 26.—*Urtica ? spinosa,* Blume, Bijdr. Fl. Ned. Ind. 507 (1825). *Epicarpurus spinosa,* Blume, l.c.

Java. Salak Mountain, *Blume*; South-east Java, *Forbes* 1204; rain-forest of East Java, up to 500 m. alt. (fide *Koorders,* l.c.), *Vernacular.* "Panawar Beas" (Sundanese).

2. **T. zeylanica,** *Thwaites,* Enum. 264 (1861); Kew Journ. Bot. iii. t. 11 (1851); Bedd. Fl. Sylv. t. anal. 26, fig. 3 (1873); Hk. f. Fl. Brit. Ind. v. pt. ii. 488 (1890), excl. specimen burmanicum; Trimen, Handb. Fl. Ceyl. iv. 100 (1898).—*Epicarpurus zeylanica,* Thwaites in Kew Journ. Bot. iv. i. (1852).—*Diplocos zeylanica,* Bureau in DC. Prodr. xvii. 215 (1873).

India. Ceylon: Haragam near Kandy, *Thwaites* 2213.

Trimen says this species is rather rare in low country from 1000-2000 ft., flowering in July, the male flowers yellow, the female green.

Hooker's identification of Griffith's Burma specimen (Kew Distrib. 4659) was, if only from a geographical point of view, worthy of a very close examination, and I find two clear differences between the Ceylon and Burma plants, the former having distinctly pedicellate male flowers and very characteristic rhomboid-elliptic leaves, the latter sessile male flowers and rather elongate-ovate, caudate-acuminate leaves. Accordingly, Griffith's plant is here made the type of a new species, *T. caudata,* Hutchinson.

3. **T. caudata,** *Hutchinson,* sp. nov.

T. zeylanica, Hook. f. Fl. Brit. Ind. v. pt. ii. 488, partim; Kurz, For. Fl. Brit. Burm. ii. 464.

Frutex vel arbor parva, spinosa, 1·7-3 m. alta; rami flexuosi, cortice brunneo minute puberulo obtecti; ramuli juniores laxe foliati, puberuli. *Folia* plus minusve elongato-ovata vel oblongo-elliptica, ad basin obtusum cuneata, in caudo integro longe acuminata, 5-14 cm. longa, 2-4 cm. lata, basin versus integra, ceterum crenato-serrata, tenuiter chartacea, glabra; costa supra inconspicua, infra prominens, basi 1 mm. crassa; nervi laterales utrinsecus circiter 8, arcuati, infra prominuli; petioli graciles, teretes, 3-5 mm. longi, puberuli; spinae axillares durae, usque ad 1·5 cm. longae. *Inflorescentia* ♂ brevis, puberula. *Perianthii* segmenta late ovata, obtusa. *Antherae* primum valde inflexae, demum erectae; filamenta gracilia, glabra. *Ovarium* rudimentarium conicum, glabrum. *Inflorescentia* axillaris, 3-4-flora; pedicelli 5 mm. longi, in fructu usque ad 1·5 cm. longi, fere glabri. *Perianthii segmenta* 4, oblonga, subacuta, leviter accrescentia, glabra. *Ovarium* valde obliquum; stylus crassus, ramis hispidis. *Fructus* oblique globosus, nitidus, circiter 6 mm. diametro.

Burma. Upper Burma: Myitkyina District; woods towards the Serpentine Mines, Apr. 4, 1837, ♀, *Griffith* (Kew Distrib.) 4659; without definite locality, ♂, *Haines*.

Assam. Nowgong District: Lumding, Nov. 10, 1913, a small thorny tree 20-25 ft. high, with milky juice, ♀, *Upendranath Kanjilal* 2904.

4. **T. obtusa**, *Elmer*, Leafl. Philipp. Bot. v. 1813 (1913).

Philippines. Palawan: Puerto Princesa (Mt. Pulfar), Apr. 1911, ♂, *Elmer* 12966.

5. **T. ilicifolia**, *Vidal*, Revis, Pl. Vasc. Filip. 349 (1886).

Balanostreblus ilicifolia, Kurz in Journ. As. Soc. Beng. xlii. ii. 247. partim, quoad spec. Chittagongensem; et For. Fl. Brit. Burm. 465, partim; Hook. F. Fl. Brit. Ind. v. 544, partim. *T. triapiculata*, Gamble in Kew Bull. 1913, 188.

India. Eastern Bengal: Chittagong, *Hooker & Thomson*.

Burma. Bhamo, Sept., *J. Anderson*. Southern Shan States: Kengtung; Mong Nai, along streams in damp limestone gravel, 240 m., Mar. 9, 1911, *Robertson* 254-7.

Indo-China. Prov. Bien Hoa: Mt. Lu, Mar. 1877, *Pierre* 3281.

Malay Peninsula. Lower Siam: Trang Island, Mar. 1881, *King's Collector* 1435. Perlis; Kanga, Mar. 1910, *Ridley* 14956; Kedah; Alasta, Feb. 1910, *Ridley* 14958; Pulau Adang, Apr. 1911, *Ridley* 15714; Penang Waterfall, Apr. 1890, *Curtis* 2289; Mar. 1915, *Ridley*; Pahang; Tsmerloh, *Ridley* 2309a.

Malay Archipelago. Celebes: Minahassa Province, *Koorders* 19625.

Philippine Islands. Luzon: various localities, *Vidal* 904, 905, 1783; *Loher* 5222, 5223; *Ahern* 14. Marinduque Island, South of Luzon, *Vidal* 1794,1795. Paragua Island, *Vidal* 3770.

Basilan Island, W. *I. Hutchinson* For. Bur. no. 3443. Palawan Island; Puerto Princesa (Mt. Pulgar), Mar. 1911, *Elmer* 12853. Silanga, May 1913, *Merrill* 9603.

In Luzon the vernacular name is "Cuyos cuyos." Mr. H. N. Ridley informs me that the leaves of this plant in the Peninsula are gilded over by the Tamils and used as a substitute for holly at Christmas; the wood is used for walking-sticks, and is so hard and heavy that it sinks in water.

6. **T. laxiflora,** *Hutchinson*, sp. nov..

Arbor parva dioica, frequenter spinosa; rami flexuosi, juniores laxe foliati, puberuli. *Folia* ilicina, obovata vel obovato-oblanceolata, apice obtusa et tridentata, basi cuneata, 4-7 cm. longa, 2-3·5 cm. lata, acute spinoso-dentata, rigide chartacea, sicco cinerea, glabra; costa media supra angusta, prominula, infra prominens, straminea; nervi laterales utrinsecus 7-8, gracillimi, marginem versus conjuncti, infra prominuli; petioli 5 mm. longi, puberulo-hispidi. *Inflorescentia* ♂ axillaris, pedunculata, dependens, circiter 1·5 cm. longa; pedunculus gracilis, 4 mm. longus, hispidulus. *Flores* subsessiles albi. *Perianthii segmenta* oblongo-lanceolata, acuta, fere glabra. *Flores* ♀ ignoti.

Indo-China. Tonkin: near Tu-phap, in the woods, Apr. 1888, *Balansa* 2481, 2482.

7. **T. Balansae,** *Hutchinson*, sp. nov.

Arbor 7-8 m. alta; rami laxe foliati, sicco flavo-virides, glabri, profunde sulcati. *Folia* oblongo-elliptica vel obovato-elliptica, basi obtuse rotundata et leviter inaequilatera, apice in caudam 2-4 cm. longam subacutam integrum abrupte vel subsensim attenuata, 8-20 cm. longa, 3-7 cm. lata, obtuse crenato-serrata, basin versus integer. rigide chartacea, sicca pallide viridia, glabra; nervi laterales utrinsecus circiter 8, leviter arcuati, prope marginem ascendentes et eo subparalelles, infra prominentes, nervis tertiariis et venis infra laxis; petioli 5-8 mm. longi, interdum verruculosi. *Inflorescentia* ♂ spicata, axillaris, gracilis, usque ad 6 cm. longa. *Perianthii segmenta* puberula. *Flores* ♀ juniores non visi. *Perianthii fructiferi* segmenta coriacea, rotundata, usque ad 1 cm. longa. *Fructus* glaber, oblique obovoideus, stylo bilobato erecto coronatus; pedicelli usque ad 1 cm. longi.

Indo-China. Tonkin: forests of the Lankok valley, Mar. 4, 1888, ♂, *Balansa* 2477; near the Thuang-Lam, May 2, 1888, ♀, *Balansa* 2478; in the woods at Tu-phap, May 1887, ♀, *Balansa* 2479.

Species imperfecte cognita.

8. **T. macrophylla,** *Boerl.* Hand. Fl. Ned. Ind. iii. 359 (1900); Koorders, Exkurs.-Fl. Java, ii. 87 (in obs.).—*Streblus macrophyllus*, Blume, Mus. Bot. Lugd.-Bat. ii. 80 (1856); Miq. Fl. Ind. Bat. i., pars. ii. 278 (1859). *Diplocos macrophylla*, Bureau in DC. Prodr. xvii. 216 (1873).

Malay Archipelago: Celebes; near Likupang, coll.?

The only specimen of *Taxotrophis* at Kew from the Celebes is one (a single leaf) collected by Koorders, quoted under *T. ilicifolia*, with which it is apparently identical.

Balanostreblus, *Kurz.*

Descr. emend.—Flores dioici, masculi ignoti; foeminei racemosi; perianthium cum ovarii parte inferiore adnatum, medio constrictum, carnosum, verrucosum, apice perforatum, styli basin circumdatum, haud lobatum. *Ovarium* semisuperum, carnosum, 1-ovulatum, ovulo apice loculi pendulo; stylus brevis, e perianthii orificio protrudens, ramis 2 brevibus recurvatis crassis verruculosis. *Drupa* (ut videtur) perianthio carnoso verrucoso inclusa, monosperma.—*Arbor* parva, sempervirens, lactescens (*Kurz*); folia alterna, grosse spinoso-dentata et nervosa.

B. ilicifolia, *Kurz* in Journ. As. Soc. Beng. xlii. ii. 247, t. 19 (quoad description et iconum, excl. specim. e Chittagong.).

Ramuli divaricati, glabri, cortice cinereo verrucoso obtecti.

Folia petiolata, oblonga vel elliptico-oblonga, acute spinoso-acuminata, basi breviter cuneata, 5-10 cm. longa, 2·5-4 cm. lata,

grosse spinoso-dentata, dentibus utrinsecus 3-9, rigide coriacea, glabra, supra nitida, infra leviter pallidiora et laxe reticulata; costa supra paullo immersa, infra valde prominens et semiteres, basi circiter 1·5 mm. crassa; nervi laterales utrinsecus 8-10, a costa sub angulo latissimo abeuntes, marginem versus prominenter bifurcati et conjuncti, juncturis in dentibus spinosis productis, supra vix evidentes, infra valde prominentes, nervis tertiariis laxis infra prominulis; petioli 4-6 mm. longi, 1·5 mm. crassi, transverse verrucosi. *Racemi* ♀ e ramis annotinis penduli, circiter 3 cm. longi, pauciflori; rhachis robustus, puberulus; bracteae minutae; pedicelli crassi, 2·5-3 mm. longi, hispiduli. *Perianthium* circiter 4 mm. longum, apice perforatum, medio constrictum et superne ovario liberum, extra verruculosum, haud lobatum; ovarium carnosum, glabrum; stylus 1 mm. longus, ramis 1 mm. longis arcte recurvatis verruculosis.

Burma. Known only from a cultivated specimen in the Calcutta Herbarium, probably grown from a plant or seeds collected at Ava by *J. Anderson*.

XII.—ROSA GLUTINOSA.

R. A. Rolfe.

For some time it has been suspected that the Rose long cultivated and recently figured as *Rosa glutinosa* (Willmott, Rosa, p. 467, tab.) does not agree with the original *R. glutinosa*. Sibth. & Sm., at all events as figured by the authors, and a comparison of materials, with the aid of a specimen from the Sibthorpian Herbarium at Oxford, kindly lent by Prof. S. H. Vines, reveals an amount of confusion that it seems desirable to clear up as far as possible.

Rosa glutinosa, Sibth. & Sm., was originally described in 1806 (Sibth. & Sm. Fl. Graec. Prodr. i. p. 348), and based on "*R. cretica montana foliis subrotundis glutinosis et villosis*, Tourn. Cor. 43," the habitat being given as "In Cretae montibus Sphacioticis." A figure is also cited, which was subsequently published in Sibth. & Sm. Fl. Graec. t. 482. In this later work we find the additional references, "Lindl. Ros. 95," and "*R. pumila alpina, pimpinellae exacte foliis sparsis, spinis incurvis, aquate purpurea*, Cupan. Panphyt. ed. 1, v. i. t. 61." Turning to Lindley, we find the further synonym, "*R. rubiginosa cretica*, Redout. Ros. i. 93, 125, t. 50," with the localities, "Hab. in Parnasso, Sibthorp; Siciliae montibus (Cupani); Cretae, Tournefort (v. s. sp. herb. Smith & Banks.)" There is also the note, "For the synonym of Cupani, I trust to Sir James Smith. No copy of the *Panphyton* containing t. 61 has fallen in my way. . . It appears from Redoute's figure, which is less happy than usual, to be cultivated in France; our own gardens it has not yet reached." Comparison of the figures and specimens cited shows a considerable amount of confusion, and the references cited include more than a single species.

R. glutinosa was thus based upon materials from two different sources, first on the "*Rosa cretica montana*" of Tournefort,

to which the locality cited presumably belongs, and second on Sibthorp's figure and the specimen from which it was drawn, which we believe to be different. In any case, it includes more than a single species, and as Sibthorp's materials are not in doubt we will consider them first. Redoute's and Cupani's specimens are not concerned in the original publication.

There is an original sheet of *Rosa glutinosa* preserved in Sibthorp's Herbarium at Oxford, named, but unlocalised, except that the sheet is placed in a folded cover of blue paper on which is written "Mt. Olympus." Mr. Druce, however, tells me that no reliance can be placed on this circumstance, as the cover is of a later date. This sheet contains three branches, which have been named by Crepin as follows: "*a*, *R. glutinosa*, Sibth. & Sm.; *b*, *R. glutinosa* var. *lasioclada*, Christ.; *c*, and *R. glutinosa* var. *lasioclada*, Christ?" The word "*lasioclada*" is evidently a slip for *leioclada*, Christ. in Boiss. Fl. Orient. Suppl. p. 222, which is localised as from the mountains of Greece. This var. *leioclada* is a form without glandular aciculi on the branchlets, and is actually the form figured by Sibthorp. The absence of aciculi is probably due to its representing a mature state, for other specimens of *R. glutinosa* show the same condition, and the specimen marked "*a*" only differs in having traces of these aciculi. In the younger specimens there is generally a copious development of the glandular aciculi on the branchlets.

There is also a sheet from Sibthorp in the Natural History Museum, South Kensington. It is labelled as follows: "*R. glutinosa*, F. Graec., J. L.; aff. *villosa*, n. 8. *Rosa parnassi*, Sibth." To this Crépin has added: "Veros. *R. Heckeliana*, Tratt., Crép." "J. L." represents Lindley, whilst the specific name, *R. parnassi*, Sibth., though not originally published, was afterwards recorded by Crépin (Bull. Soc. Bot. Belg. xviii. p. 395). It indicates the locality where the plant was collected as Mt. Parnassus, Greece, where Heldreich subsequently obtained it. Borbas has since referred *R. parnassi* doubtfully to his *R. Heckeliana* var. *semihaplodonta* (Prim. Mon. Ros. Hung. p. 499), and in any case it is a form of *R. Heckeliana*.

We now come to Tournefort's original Cretan plant, which remains uncertain, for the description is inadequate and no specimen is known. Tournefort's specimens are at Paris, and have formed the subject of a paper by Sieber (Isis, 1853, pp. 455-462), but no Rose is mentioned. Raulin (Descr. Crète, Bot. p. 448) enumerates only three Roses as natives of Crete, *R. sempervirens*, *R. canina* var. *atrovirens*, and *R. glutinosa*. Under the latter he includes Redoute's synonym above mentioned, *R. resinosa*, Stern. Spach. Phan. ii. p. 24, which was based on Redoute's figure, and *R. rubiginosa* var. *sphaerocarpa*, Desv. in Journ. de Bot. ii. (1813), p. 118, a Rose from the French Alps. Raulin gives the locality as "Montagnes de Sphakia (Tourn., Sibth., Sieb.)," but this does not carry the question any further except as to Sieber's materials, of which a specimen is preserved at Kew. It is a fruiting specimen, quite distinct from that figured by Sibthorp, and from its softly villous leaflets and petioles is apparently a luxuriant form of *R. Heckeliana*, Tratt.,

with rather large leaflets, and an ellipsoid, very glandular fruit (in fully mature condition). The only other Cretan materials at Kew are in flower, and are typical *R. Heckeliana*, collected by Dr. A. Baldacci, in 1893, at Hagia-Pneuma, one of the summits of the Asprovuna Mountains, south of Khania, a locality some distance to the north-west of Sphakia, whence Sieber's specimen was obtained, and Tournefort's specimen also may well have been *R. Heckeliana*. At all events we find no evidence that the form figured by Sibthorp occurs in Crete.

This brings us to *R. rubiginosa cretica*, Red., which is held to include *R. cretica*, Tourn.—a view also taken by Thory (Prodr. Monogr. Ros. p. 110) and Trattinnick (Ros. Monogr. ii. p. 83)—but Redoute's figure is very different from that of Sibthorp, having far larger, simply serrate leaflets, and flowers of quite double the size, while the spines are reduced to a single stipulary pair. Trattinnick (Ros. Monogr. ii. p. 83) mentions a *R. cretica*, Vest., as differing from Tournefort's plant, and this is described by Sternberg (Flora, ix. i. pp. 74, 76) as *R. resinosa*. For this *R. resinosa*, Reichenbach suggests (Fl. Germ. Excurs. p. 616) the hybrid origin, "*R. rubiginoso-villosa*," but Crépin make no mention of such a cross. R. Keller (Ascherson & Grabn. Syn. Mittel.-Europ. Fl. vi. p. 67) makes of *R. resinosa*, Sternb., a variety of *R. pomifera*, Herrm., while at the same time (p. 106) citing *R. rubiginosa* var. *cretica*, Red., as synonymous with *R. glutinosa*, Sibth. & Sm. The *R. cretica*, Wallr. Ros. p. 144, is a complete mixture, including the forms already mentioned and several others, so that it throws no additional light on the question.

Lastly, we have Cupani's figure, which is in the Linnean Society's copy of the Panphyton, though absent from the one at the Natural History Museum. There is a corresponding specimen in the Linnean Herbarium, the one alluded to by Lindley in his phrase, "(v. v. sp. herb. Smith)." It is inscribed "*Rosa pumilla alpina Pimpinellae exacte folis* (sic) *sparsis spinis incurvis aquate purpae*, Cupani, Pan. Sci. t. 61." There is also a ticket: "*Rosa cretica montana fol. subrotundis glutinosis et villosis. Corolla rosea frutex humilis.* Inst. Cor. 43." The reference is to Tournefort's Corollarium, and Dr. B. Daydon Jackson informs us that the ticket is in the handwriting of Pietro Arduino (1728-1805), who sent many plants of Italian and garden origin to Linnaeus. It is a fruiting specimen, and agrees in every respect with *R. sicula*, Tratt., Ros. ii. p. 68, as was suspected from the locality. *R. Heckeliana*, Tratt., also occurs in Sicily, but is markedly different in its softly villous leaflets and petioles.

It is fortunate that the clearing up of the confusion about *R. glutinosa* does not necessitate any change of name, for both name and character primarily belong to the plant figured by Sibthorp, though other things were inadvertently included. This is in agreement with its use in later Floras. The *Rosa glutinosa* of cultivation, however, and figured at p. 467 of Miss Willmott's Monograph, differs in its far more slender straight prickles, whilst the fruit is broadly ellipsoidal and twice as large as that figured by Sibthorp. The Kew plant of this name was obtained

from Darmstadt in 1896, but its original source is not known. It very closely resembles *R. dalmatica*, A. Kern. (Bot. Zeitschr. xx. p. 10), except that the latter has globose fruit. This, however, Dr. Christ regards as a form of *R. glutinosa*, and we are inclined to think that it must be called *R. glutinosa*, var. *dalmatica*, Borbas (Prim. Ros. Mon. Hung. p. 501), for Borbas, after describing the fruit as globose, adds "in cult. ovoideus," and this represents precisely the difference of the cultivated plant, so that it would be interesting to ascertain its wild origin and the reason for the modified form of the fruits. The question of hybridity is not excluded. Miss Willmott has a second plate called *R. glutinosa* (p. 468, tab.), which closely resembles a Cilician Rose to which the name of *R. poteriifolia*, Schott & Kotschy, has been applied, but which is also considered to be a form of *R. glutinosa*. Whether any of the variations observed in *R. glutinosa* are the result of hybridisation cannot yet be determined with certainty, but natural hybrids with *R. Heckeliana*, *R. glauca*, and *R. moschata* are recorded by Dr. Christ, and it is possible that there may be others as yet unrecognised. As to the Cretan Roses, further observations and materials are desirable.

XIII.—MISCELLANEOUS NOTES.

Major S. M. Toppin's Bequest to the Royal Botanic Gardens.—By the will of the late Major Toppin, R.A., M.C., who, we deeply regret to record, was killed near Ypres on September 24, 1917, the Herbarium has been enriched by the valuable collection of dried plants accumulated by him during his several years' residence on the North-Western Frontier of India and in Northern Burma. The specimens, nearly all of which were collected by Major Toppin himself, are mainly from the region of Chitral. Most of them are mounted and many are named, and while the whole may be described as excellent, the specimens of *Impatiens*, numbering 139 sheets, are particularly so, and the value of many is much enhanced owing to their being accompanied by type-written descriptive notes and in some cases by coloured sketches of the flowers. An appreciative reference to the collection is made by Sir J. D. Hooker who, commenting on botanical exploration in Chitral (*Kew Bull.* 1911, p. 210), wrote:—"An extensive, carefully ticketed, and beautifully preserved herbarium of Chitral plants has been formed by Lt. Toppin, R.A., who has kindly sent me the Balsams it contained." Altogether, the collection comprises about 1110 sheets, supplemented by a large number of fruits in boxes and glass-tubes. In addition there are eight note-books, various memoranda, and numerous letters, including several from Sir J. D. Hooker, relating to specimens collected by Major Toppin, and a useful sketch-map of the Chitral region. Some of the specimens have been compared in the Kew Herbarium by Major Toppin himself and by members of the staff, and it would appear that several of them represent undescribed species.

Amongst the memoranda are notes on districts visited and records of observations on pollination and dehiscence of the cap-

sules in various species of *Impatiens*, indicating most methodical and painstaking work. In the mounting and arranging of the specimens Major Toppin was fortunate in having the assistance of his mother, who encouraged his early interest in botany, and to whose devotion and accomplishments his marked efficiency as a collector was in some measure due.

Sidney Miles Toppin was the younger son of Major-General J. M. Toppin, late of the Royal Irish Regiment, and Mrs. Toppin, of Westminster Cottage, Branksome Park, Bournemouth, and was born June 12, 1878, at Clonmel, Ireland. He was educated at Clifton College, and at Gonville and Caius College, Cambridge, and was working for a medical degree when he was offered a direct commission in the Royal Artillery. This he accepted and was gazetted in May, 1900, and proceeded at once to India. After qualifying in Hindustani he was given the charge of a native mountain-battery and went to the Afghan Frontier. While stationed at Chitral, where he spent two years, he applied his spare time to studying and collecting plants, continuing these pursuits later on when removed to Northern Burma. On obtaining his company he received an appointment in Egypt. Returning to England in 1914 he married, and was about to leave for India when war was declared. Instead, therefore, of returning to India he was sent to Ireland, where he formed a battery, and later to France. He saw much hard fighting, was mentioned in despatches, and for his services at the battle of Loos was awarded the Military Cross. His record as an able military officer, his work accomplished in the service of botanical science, and the amiable qualities which endeared him to his family and friends, secure as they have made his claim to lasting and worthy remembrance, cannot but accentuate the sense of loss occasioned to so many by his untimely death. Major Toppin leaves a widow and infant daughter. His elder and only brother, Capt. H. S. Toppin, who did some excellent survey work (*see* Geogr. Journ., vol. xliv. p. 508), was killed in the battle of the Aisne, Sept. 14, 1914.

Presentation to the Herbarium.—A collection of upwards of 400 specimens of dried British plants made by the late Rifleman John Divers, Queen Victoria Rifles, has been presented by his father, Mr. J. J. Divers. John Divers was a gardener at Kew from March, 1912, to December, 1914, and was promoted to be Sub-foreman in the Herbaceous and Alpine Department in 1913. He joined the 25th London (Cyclists') Regiment in December, 1914, and later was transferred to the Queen Victoria Rifles. At the end of July, 1916, he went to France and after an engagement on October 8-9, 1916, was posted as "missing, believed killed."

The collection received was commenced in 1908, when Mr. Divers was employed at Belvoir Castle Gardens, with plants from Belvoir and district, and was continued in the neighbourhood of Kew in 1912 and 1913; a few specimens being added from Reigate. The specimens (entire plants where possible) have been selected with exceptional care and are well displayed on the sheets on which they are mounted.

A New Tanning Bark.—Under the name of "Kahua" (Hindu) a sample of bark from India was recently received from a tanning expert in this country for determination, with a note to the effect that it has been found upon experiment to give a pinkish leather, but nevertheless appears to be quite a good tanning material. The sample varies in thickness up to $\frac{1}{3}$ in., is somewhat smooth and of a pinkish-grey colour. It has been identified as *Terminalia Arjuna*, Bedd., described by Gamble in "A Manual of Indian Timbers" as a large deciduous and beautiful tree found on the banks of rivers and streams throughout Central and South India, extending as far north as Oudh. Beyond that towards the North-west and in the Punjab it is found only as a cultivated tree. It is also found in Burma and in the low country of Ceylon. With regard to the applications of the bark in India it is employed both in dyeing and tanning and in medicine as a tonic and to heal wounds. In "Pharmacographia Indica" Dymock gives the following particulars of the chemical composition of the bark:—"This is most remarkable, the ash amounts to 34 per cent. of almost pure calcium carbonate, which, if calculated into oxalate would amount to 43·5 per cent. The watery extract is 23 per cent. with 16 per cent. of tannin; very little colouring matter besides the tannin is extracted by alcohol. The tannin gave a blue-black precipitate with ferric salts." A note on Myrobalans, the well-known fruits of an allied species, *Terminalia Chebula*. Retz., an important tanning material, appeared in *Kew Bulletin*, 1909, p. 209. J. M. H.

Bay Oil and Bay Rum.—The manufacture of bay oil and bay rum are important industries in the West Indies which have been developed chiefly during the last fifty years. Bay oil is the product of the leaves of the "West Indian bay tree," *Pimenta acris*, Kostel., which is known locally by several other names, and the oil is used in the manufacture of bay rum, which is largely used as a hair wash. The leaves are gathered, chiefly from wild sources, and the volatile oil extracted by a process of distillation.

The industry has suffered much from the admixture of the leaves of two forms of *Pimenta acris* known as "Bois d'Inde Citronelle" and "Bois d'Inde Anise," which are so similar as to be separated with difficulty. "Bois d'Inde Citronelle" is known botanically as *Pimenta acris*, var. *citrifolia* (P. citrifolia, *Kostel.*, Myrtus citrifolia, *Poir.*); the oil has the taste and odour of lemon, owing to the presence of "Citral," which reduces the value of the true bay oil if mixed therewith. "Bois d'Inde Anise" does not appear to have been distinguished botanically, but its oil also is an equally undesirable product which reduces the value of bay oil. The true economic plant is known as "Bois d'Inde," or bay rum tree. The frequent appearance of the leaves of these two varieties amongst produce sold as "Bois d'Inde" leaves is not only a matter of considerable inconvenience and possibly loss to distillers of bay oil, but tends to give a bad name to the Dominica samples of bay oil leaves submitted to distillers.*

* *See* Report on the Agricultural Department, Dominica, 1916–17, p. 2.

Leaves and flowering branches of all three forms have been submitted to Kew by Mr. J. Jones, Curator, Botanic Garden, Dominica, with a view to the detection of any botanical characters by which they can be distinguished, but the principal difference detected is in the fragrance of the bruised leaves, that of the "Bois d'Inde Citronelle" being citron-scented, while the others are simply aromatic, a character difficult to utilise in collecting leaves from wild sources, and of little practical value as a means of subsequently detecting adulteration. Moreover, it failed in separating the "Bois d'Inde Anise," and it is not yet clear why this particular variety fails to reach the desired standard as regards its essential oil. The specimens have been subjected to botanical comparison, and to more detailed examination in the laboratory, but no conspicuous differences have been observed.

Mr. Jones remarks that the varieties have been cultivated in the Botanic Gardens for fifteen years, and that they were obtained as representing the true varieties. The differences there observed are thus defined:—"The Bois d'Inde Citronelle is possessed of a lax growing habit, which is quite distinct from the compact erect habit of the "Bois d'Inde Anise. The appearance of Bois d'Inde approximates that of Bois d'Inde Anise, but is less compact. The cymes of Bios d'Inde Citronelle are larger than those of Bois d'Inde Anise and several times larger than those produced by the true Bois d'Inde."

Fruiting specimens are not yet available, Mr. Jones having stated that the trees have not yet borne fruit. Any differences here, however, if they exist, would be of no practical value as a guide in gathering the leaves before the fruits are developed.

A summary of the question has been given in the *Kew Bulletin*, Addit. Series, ix. pp. 316-317, and Weisner, who cites Sawer, Odoragraphia, vol. ii. p. 56, states that the bay leaves of commerce are mixtures of leaves of several different species.

In the event of the plant being brought under cultivation, as has been suggested, owing to the inaccessibility or destruction of the trees in their wild habitats, steps should be taken to ensure that the plants selected had been derived from a pure stock of true *Pimenta acris*, Kostel. At present the leaves are collected from the wild plants in several islands, including Dominica, Porto Rico, Montserrat, St. John's, the Virgin Islands and other localities.

It would be interesting if, as suggested by Mr. Jones, accurate observations were made on these points in all the islands in which *Pimenta acris* is native, and in which bay oil is manufactured, with a view to clearing up these long-standing questions.

This case of varietal forms of *Pimenta acris* affords a parallel to those of Camphor, *Cinnamomum camphora*, and Chicle Gum, *Achras Sapota* (*See* Report on Agric. Dept. Dominica, 1914-15, p. 11). Of both these plants more than one form is known to exist and the present instance affords yet another example of the absolute necessity of making sure of the value of any particular strain or physiological form of an economic plant before establishing plantations on an extensive scale.

Mr. Jones informs us that *Pimenta acris* and its varieties exist in great numbers on poor soils near the coast.

A note on bay oil and lemon-scented bay oil, and their distillation, with figures of the necessary stills, appeared in the West Indian Bulletin in 1908 (vol. ix. pp. 271-277), but no mention is there made of "Bois d'Inde Anise."

When the lemon-scented Pimento was brought to the knowledge of Kew, some 35 years ago, the plant was propagated and distributed between the years 1885 and 1889 to Jamaica, Demerara, Lagos, Queensland, Fiji, Ceylon, Java and Singapore.

The Peaches of New York.*—Kew is indebted to the Director of the New York Agricultural Experiment Station for a copy of this work—the fifth of the series, the previous ones having been devoted to apples, grapes, plums and cherries. The qualities of thoroughness, accuracy and comprehensiveness which have characterised previous volumes are equally evident in this. To general readers the earlier part of the work will probably most appeal, as it deals with the broader phases of the subject, such as the history of the peach and its botanical and horticultural classifications. But over 300 pages are given up to the description and history of individual varieties grown and raised in all parts of the world, to diseases, commercial peach-growing, etc., and it is this part which those engaged in peach cultivation as an industry, or as part of their ordinary avocation, will regard as of highest value. No less than 86 of the more popular and important varieties are illustrated by coloured plates, admirably reproduced.

The association of the peach in legend as well as in name was for long with Persia, but that country, in spite of the testimony of ancient writers, is no longer regarded as the native country of *Prunus persica*. The tree has established and naturalised itself firmly in many of the countries to which it has been introduced and this has increased the difficulty of determining its real origin. The view has been upheld for some time that the first home of the peach was China, and in this work Mr. Hedrick brings forward evidence which seems to prove conclusively that this is true. It is interesting to learn that the peach has a greater commercial value in the United States than all other stone fruits, i.e., plum, cherry, almond and apricot, put together. The theory supported by Chas. Darwin, Thos. Andrew Knight and others of lesser note that the peach is a derivation of the almond is not endorsed by Mr. Hedrick. Although the title of this book implies a special relationship with the State of New York, the work really constitutes an encyclopedia of the peach and its value will be appreciated wherever this fruit is grown.

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* The Peaches of New York: Report ii. of the N.Y. Agricultural Experiment Station, 1916; J. B. Lyon Company, Printers, Albany, N.Y., 1917.

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ROYAL BOTANIC GARDENS, KEW.

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XIV.—THE BRITISH SPECIES OF MELANCONIUM.

W. B. Grove.

The species of *Melanconium*, like many others of the commoner *Coelomycetes*,* have been much confused by authors and collectors. In the absence of authentic specimens (usually few in number) and of spore-measurements (which were rarely or never given by the earlier mycologists), there is nothing in these minute fungi to rely upon but spore-form or general outward appearance, which without the help of plates can only be conveyed correctly by a careful choice of words. Hence the enormous confusion, and in the genus *Melanconium* this has been perpetuated and as it were stereotyped by a few unfortunate errors in Saccardo's Sylloge.

The following account of the British species will show that they can be arranged in three distinct sections:—

§ 1. **Melanconium** (sens. strict.), with smoky-brown or blackish spores, exuding as tendril-like masses.

§ 2. **Lamproconium,** with bright coloured spores (in this case, blue).

§ 3. **Ectoconium,** with olivaceous spores, which form in the end a pulverulent shapeless dispersed mass.

The spores in the pustules of the first section are more or less embedded in mucilage and usually therefore, when soaked with moisture, exude through the orifice above the pustule in the shape of long strings or tendrils, which when beaten down by the rain assume the form of a thin black layer closely adherent to the exterior of the bark around the orifice.

In the third section, owing to the want of this mucilage, the spores on their escape become scattered over the matrix as an

* See *Kew Bulletin*, 1917, p. 51.

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irregular effused powdery stratum, which does not in any way adhere to the surface. This powderiness, as will be seen, has led to serious misconceptions.

§ 1. MELANCONIUM.

1. **Melanconium bicolor,** *Nees*, System, 1817, p. 32, tab. 2, f. 27, and

2. **Melanconium betulinum,** *Schmidt & Kunze*, Exsicc. no. 208, 1819.

Perhaps the most far-reaching mistakes have been made in regard to the *Melanconia* on Birch. The differences between *M. bicolor*, Nees and *M. betulinum*, Schmidt et Kunze, as stated in the Sylloge, vol. iii, pp. 755-6, are, it is true, nearly correct. The descriptions of the two species are given by Link, in Linnaeus' Species Plantarum, 1825, ed. iv, vol. 6, pt. 2, from which it appears that for him the only tangible distinction was that the spores of the latter seemed to be 1-septate: for this reason he placed them in different genera.

The starting point of the investigation must lie in *M. bicolor*. The essential points described by Nees (l.c.) are that the fungus occurred in Oak, and that the spores were "eyförmig." He figures them as distinctly ovoid, but on the whole not much longer than broad. Link (l.c. p. 92) does not make the matter clearer; he describes the spores as "subglobosis oblongisque," and the habitat as "in ramis dejectis variarum arborum"; but luckily he adds the synonym "*M. discolor*, Schmidt et Kunze exs. n. 157" (published in 1817). An examination of this exsiccatum shows that the spores tend to be distinctly obovoid (rarely subglobose or oblong), not opaque, with one guttule, and measuring on the average 10-12 × 6-8 μ. This agrees with the fungus called below no. 1.

The other fungus, which seemed to Link to be uniseptate, is called by him (l.c. p. 94) *Didymosporium elevatum*, Link; he cites as its type "*Melanconium betulinum*, Schmidt et Kunze exsicc. n. 208" (published in 1819), and gives the habitat as "corticibus Betularum et Fagorum emortuis." An examination of this exsiccatum shows that the spores are narrowly almond-shaped, rather pointed at the lower end, somewhat granular within, with thicker walls than in no. 1, and therefore somewhat opaque. They measure up to 17 μ long, but the mature forms average about 13-16 by 5-6 μ; they vary also towards being obovoid and subpyriform or even oblong, but present usually a very different appearance from those figured by Nees. This is the fungus called below no. 2.

On investigation of the specimens issued by various mycologists during the succeeding years, they are found to be curiously mixed, but the two types mentioned occur again and again under different names: a list of some of them is given below. It is plain that no. 1 is the true *M. bicolor*, Nees, and no. 2 is the true *M. betulinum*, Schmidt et Kunze. By the initials "*v. v.*" which he appends to each, it is seen that Link was fully acquainted with both. It may be asked then, why he thought

that *M. betulinum* was 1-septate and *M. bicolor* not so: the answer lies in a peculiarity of the contents of the spores. In *M. bicolor* there is, in the majority of cases, a clear central oil-guttule, which may, however, sometimes lie towards either end, or may, though rarely, be divided into two or even three smaller ones. In *M. betulinum* there is seldom such a clear single central guttule, but more often two vacuolar spaces, which approach one another in the middle, and one of which may contain an oil-drop with a square outline towards the centre of the spore. In many, but by no means all of them, there is therefore, under a low power such as Link used, a distinct simulation of a median septum. This appearance vanishes altogether under a higher power, but has misled several observers, Greville, Vestergren, etc.

As regards outward aspect, there seems to be a decided tendency in *M. bicolor* to burst out through a roundish opening, and in *M. betulinum* through an elongated lanceolate fissure. But on a wider examination of many specimens this rule is seen to be subject to so many exceptions that it is impossible to name the two species by external appearance only. In fact they may not be really distinct, but as Tulasne thought two extreme forms of one species. Personally I incline more and more to this view of them as the end terms of a lengthy series, but in the majority of cases the spores appear as if perfectly distinct, and many thousands of species accepted at the present day, both in fungi and in other groups, rest upon no better foundation.

The following exsiccata, among others, have been examined:—

No. 1. **M. bicolor,** *Nees* (spores 10-12 × 6-8 μ).

"*M. discolor*," Holl, Schm. et Kunz. no. 157!
"*M. betulinum*," Desm. Crypt. Fr. no. 135!
" " Moug. et Nestl. Stirp. Crypt. no. 670!
" " Westd. Herb. Crypt. Belg. no. 132!
" " Ellis, N. Amer. Fung. no. 960!
"*M. bicolor*," Ell. et Ev., N. Amer. Fung. ser. ii. no. 2390! (the same as no. 960, and sent out as a correction of the mistake).

No. 2. **M. betulinum,** *Schmidt & Kunze* (spores 13-16 × 5-6 μ).

"*M. betulinum*," Schm. et Kunz. exs. no. 208!
" " Fckl. Fung. Rhen. no. 85!
" " Tranz. et Serebr. Mycoth. Ross. no. 293!
" " Rabenh. Herb. Mycol. ed. no. 590! (marked "= *M. effusum* L. R." in Rabenhorst's writing).
"*M. bicolor*," Roum. Fung. Sel. exs. no. 77!
" " Fckl. Fung. Rhen. no. 84!
" " Syd. Mycoth. Germ. no. 143!
" " Herb. Gerard, "Poughkeepsie, N.Y."!
" " Herb. Berk. "Thorney, Cambs."!
" " Herb. Curtis, "Weybridge, 1856"!
"*Didymosporium elevatum*," Lib. Crypt. Ard. no. 391! p.p.
" " Herb. Hook., Purt. no. 1090!
" *betulinum*, " " " no. 15!

There remains to be mentioned *M. elevatum*, Cord. (Ic. iii. tab. iv. f. 60), which according to his own showing (l.c. p. 22) was on Birch and, as he expressly states, is identical with *M. betulinum*, Schmidt et Kunze. Saccardo wrongly transfers this to Oak (Syll. iii. 753), and combines it with an English specimen on Oak from Langridge, which was named by Cooke (Grevill. xiv. 126) *M. elevatum*, but which turns out on examination to be *Dichomera Saubinetii*. *M. elevatum*, Corda, therefore entirely disappears.

The same may be said of *Didymosporium profusum*, Fr. Syst. Myc. iii. 487 = *Stilbospora profusa*, Grev. Scot. Crypt. Fl. tab. 212, f. 1 (1826). Original specimens in Herb. Kew, with the name written in Greville's own hand, are on Birch and are identical with *M. bicolor*, Nees, though he certainly included under the name several of the other species. The supposed reidentification by the writer of Greville's species in Journ. Bot. 1886, p. 197, turns out to be an error; at that time there was no opportunity of examining Greville's specimens, and his figure is decidedly misleading. The peculiar shape and position of the single guttule gives under a low power, in spores taken from the original specimens mentioned above, a very deceptive simulation of a median septum. The same misconception no doubt accounts for some of the other species placed under *Didymosporium*.

3. **Melanconium zonatum**, *Ell. & Ev.* in Peck, 44th Rep. New York State Mus., 1890, p. 136.

This fungus, described on *Ostrya virginica* from Iowa, U.S.A., is represented in Herb. Kew by a specimen issued by Ellis, North American Fungi no. 961! named "*M. bicolor*," a name which was afterwards corrected by the authors themselves, who issued the true *M. bicolor* in Ser. ii., no. 2390, and then altered the name of no. 961 to *M. zonatum*.

Hitherto this species has not been considered British, but there is a specimen in Herb. Berk. no. 1574 (apparently British, though no locality is given) on Birch, misnamed "on Beech." The spores of this differ from *M. bicolor* exactly in the characters assigned to *M. zonatum*, and it is no doubt that species. *Ostrya* and *Betula* are closely allied genera.

The following is the description of the British specimen:—

Pustules scattered, black, round, about 1 mm. diam., slightly elevated and erumpent in a depressed-conical fashion, the whitish stroma hardly ever showing. Spores obovoid, or oblong and then faintly curved in profile, rounded above, somewhat pointed at times below, dusky-brown, 10-12 × 7-8 μ, marked across the middle by a paler semipellucid zone which in profile is seen to be caused by a large vacuolar space (not oil guttule).

On bark of Birch (Herb. Berk. no. 1574!), mixed with *Libertella betulina*.

The type-specimen on *Ostrya* differs only in having more distinctly oblong or subcylindrical spores, measuring 13-15 × 6-7 μ; the spores have the same dusky colour, which is different from that of *M. bicolor*, and the same median zone, due to the same cause. The whitish stroma is not really wanting, as Ellis

and Everhart allege; a horizontal section of their own specimens will show it, but it does not protrude through the spore-mass and make a white "eye" so often as happens in *M. bicolor*. The British specimens are practically intermediate between *M. zonatum* and the typical *M. bicolor*, of which the former might well be considered to be only a strongly marked variety.

4. **Melanconium stromaticum,** *Corda*, Ic. Fung. i. 3 (1837); Sacc. Syll. iii. p. 750.

This species presents the usual source of confusion, in that it was considered by the earlier authors to include what we should now call several species. But there is one certain guide available: Corda, in Sturm's Deutschland's Flora, states definitely that one of the original specimens was discovered near Friedland in 1830 on *Carpinus*, though he also included forms on *Fagus*, on *Juglans*, and on fruit-trees. To this Saccardo has added greater confusion, by a misconception of Corda's words in the *Icones*, i. 2, concerning his variety *ramulorum*. Corda expressly states that it occurs "in ramulis, ubique," meaning as the context unmistakably shows "in ramulis *Betulae albae*." What Corda was thinking of is evidently that form of *M. bicolor* which does, as a matter of fact, occur everywhere upon the smaller branchlets of Birch. Saccardo, not perceiving this, applies the name *M. bicolor*, var. *ramulorum*, to a *Melanconium* on *Carpinus*, being misled by what Fuckel had previously done (Symb. Myc. p. 188).

On examining the published exsiccata, one finds that specimens identical in all respects have been issued under the names *M. stromaticum* and *M. ramulorum*. It will be better, therefore, to retain the former name for this species on *Carpinus*, which is seen even with the naked eye to be different from others, and agrees fairly well with Corda's figure in Sturm except that it does not have so large a stroma.

The following exsiccata have been examined:—

"*M. stromaticum*,"	Fckl. Fung. Rhen. no. 90!
,, ,,	Rabenh. Fung. Eur. no. 1290!
,, ,,	Oud. Fung. Neerl. exs. no. 294!
"*M. ramulorum*,"	Roum. Fung. Gall. exs. no. 1432!
,, ,,	Thüm. Mycoth. Univ. no. 1882!

Fuckel's no. 90 and Roumeguère's no. 1432, though gathered far apart in space and time, look as if they might have formed part of the same gathering. A description of this species is appended.

Pustules scattered, 0·5-1·5 mm. diam., covered by the bark, circular, very depressed, sometimes almost flat, but dehiscing in the centre by a round protruding pore, black, showing through the periderm, seated on a small pallid olivaceous stroma, always much less conical than in *M. bicolor* and usually without any white "eye." Spores obovoid, olivaceous-brown, usually with one or two guttules, resembling those of *M. bicolor*, 9-15 × 7-8 μ, often with a pale apiculus at the base, becoming at length effused round the pore as a black stain.

On dry dead twigs and branches of *Carpinus Betulus*, but I have found it once on still living twigs.

The synonymy is as follows:—

Dapsilosporium stromaticum, Corda, in Sturm, Deutsch. Flor. iii. 75, f. 38 (1837).

Melanconium ramulorum, Sacc. Syll. iii. 754.

M. bicolor, var. *ramulorum*, Sacc. Fung. Ital. t. 1978 (*non* Corda).

5. **Melanconium apiocarpum**, *Link*, Sp. Pl. ii, p. 90; Sacc. Syll. iii, p. 755.

This species is that which is also called by Saccardo *M. sphaeroideum*. The following exsiccata were examined:—

"*M. apiocarpum*," Fckl. Fung. Rhen. no. 89!
" " Rabenh. Fung. Eur. no. 469!
" " Herb. Winter, legit Auerswald!
"*M. sphaeroideum*," Roum. Fung. Gall. exs. no. 933!
" " Cooke, Fung. Brit. exs. no. 624!
" " Vize, Microfung. Brit. no. 114!
" " Syd. Mycoth. March. no. 1864!
"*M. elevatum*, f. *Alni*, Rabenh. Fung. Eur. no. 1288!

All these are on *Alnus* and they are all the same. The spores in every case are oval, ovoid or oblong, sub-pyriform or (very rarely) roundish, averaging 10-13 × 6 μ, with one or two guttules, smoky-brown, semipellucid, agreeing exactly with Corda's figures of *M. apiocarpum*, and of about the size he gives, viz.: ·000473 = 13 μ. They agree also with Saccardo's figure of *M. sphaeroideum* (tab. 1079). Corda shows clearly, and Saccardo indistinctly, the arrangement of the guttules which led to the false idea, prevalent among mycologists in the past, that *M. apiocarpum* has 1-septate spores.

M. didymoideum, Vestergr. is an extreme form of the same species. The author was misled into thinking that the fungus usually called *M. sphaeroideum* on *Alnus* had round or oval spores with one guttule in the middle; consequently, he thought that his fungus with twin guttules must be something different. This is not so, as is easily seen on examining any of the above-mentioned exsiccata.

It must be considered then that all the specimens on Alder examined belong to *M. apiocarpum*, Link, and that the true *M. sphaeroideum*, Link is another species. It will be seen that Link, in his description of the latter (Sp. Pl. p. 92), calls the spores "globosis," and says that they exactly agree with those of *M. sphaerospermum*. This statement could not possibly be made of the fungus on Alder. Moreover, he quotes as the type "*Stilbospora microsperma*, Nestl. exs. n. 384," but had only seen dried specimens. On examination this type is seen (in the Herb. Kew example) to be on *Rhamnus Frangula*, and to have mostly roundish or ovoid spores, measuring about 8-9 × 5-6 μ (occasionally 10 μ long), and really presenting, under a low power, a certain resemblance in gross to *M. sphaerospermum*. These and other specimens on *R. Frangula* also bear a close external resemblance to Link's diagnosis, and no doubt represent the fungus he had in mind. But as usual the names have been used con-

fusedly. Fuckel places under *M. microspermum* what is clearly *M. Hedrerae* (Fung. Rhen. no. 2106!), and Desmazières places under *M. sphaeroideum* several species, including, however, among them *M. apiocarpum* on *Alnus*.

It will clear up this confusion if it is agreed to consider *M. apiocarpum* as belonging typically to *Alnus*, and *M. sphaeroi-* to *Rhamnus*. Whether the two are really distinct is another question which cannot yet be answered. Link obviously considered them to be so, but as he quotes no type for *M. apiocarpum*, it must ever remain uncertain what he meant by this name, for he compares it only with *M. ovatum* (l.c. p. 89), of which he says it may be a variety with smaller and less pellucid spores. This indication, so far as it goes, is perfectly consistent with the identification here advocated.

The description and synonymy will then be as follows:—

Pustules scattered, about 1 mm. in diameter, conical, rather prominent, very black, with a central white stroma. Spores oblong or ovoid, obtuse at both ends, especially above, with one or two guttules, smoky-brown, semi-pellucid, 10-13 × 5-6 μ, appearing often falsely 1-septate and didymous, *i.e.*, subconstricted at the middle.

On twigs of *Alnus*. Not uncommon; specimens found by the late Dr. J. W. Ellis at Bridgnorth are exactly *M. didymoideum*.

Syn.—*M. sphaeroideum*, Sacc. Syll. iii. 755 (*non* Link); Fung. Ital. tab. 1079.

M. didymoideum, Vestergr. in Hedwig. 1903, xlii. 82.

No British specimens of the fungus on *Rhamnus* (*M. sphaeroideum*) have so far been seen. It will be noted that Saccardo appears to found his reference of *M. sphaeroideum* to *Alnus* on the quotation of that name by Mougeot as a synonym of his *Stilbospora microsperma*; Fuckel had expressed the same idea previously.

All the foregoing species are closely similar; the next group is distinguished by possessing much larger spores. It may be divided into three forms, which occur on Hornbeam, Walnut, and Beech respectively. The two first are said to be very similar: all of them may perhaps wander to other hosts.

6. **Melanconium magnum**, *Berk.*, Outl. p. 324 (1860); Sacc. Syll. iii. 753.

Naemaspora magna, Grev. Scot. Crypt. Flor. tab. 349 (1823).

Stilbospora magna, Berk. Eng. Flor. v. 357 (1836).

Subspecies 1. **M. carpineum**, comb. nov.

Sphaeria carpina * (? misprint for *carpinea*) Sow. Fung. tab. 376 (1803). *Naemaspora carpinea*, Baxt. no. 76.

Spores ovoid or oblong, thick-walled, dark greyish-brown, 18-25 × 10-11 μ.

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* Not *Carpini*, as usually quoted.

On dead trunks of *Carpinus Betulus*.

This is what is generally held to be the case, but personally, I have found that all the specimens on *Carpinus* attributed to *M. magnum* are either *M. stromaticum* or other perfectly distinct fungi such as *Stilbospora angustata*, Pers.

Subspecies 2. **Melanconium juglandinum,** *Kunze*, in Ficinus, Flor. Dresd. ed. II, ii. 260 (1823). Sacc. Syll. iii. 753; Fung. Ital. tab. 1081.

M. Juglandis, Corda, Ic. Fung. iii. 21, f. 58, and *forma diffusa*, f. 59 (1839).

Spores as above, usually 18-20 × 12-14 μ, but reaching even to 25 × 15 μ.

On branches and trunks of *Juglans*, sometimes attacking and killing the branches of old, but living, walnut trees; its large black tendrils sometimes cover a whole trunk.

There are also in Herb. Berk., from U.S.A., several closely allied forms—one on *Juglans regia*, with more ellipsoid and less opaque spores (*Ellis*, New Jersey, no. 2580! and N. Amer. Fung. no. 120!); a similar form on Hickory, with very opaque spores (*Ellis*, New Jersey, no. 2581!); and an effused form on *Acer*, like Corda's figure of *f. diffusa*, but with still larger spores, 30-35 17-18 μ (*Wright*, Connecticut, nos. 5615, 5646!; *Ellis*, Potsdam, N.Y., no. 1900!). Here, as in the other cases, the effused form is merely the result of exposure to the weather.

This species, no. 6, being already well-known as British, needs no further description, but the case is different with the next.

7. **Melanconium ovatum,** *Link*, Sp. Pl. ii. 89 (1825). Sacc. Syll. iii. 758.

Stilbospora ovata, Pers. Obs. Mycol. i. 31, tab. 2, f. 2 ("*in truncis fagineis*"); Syn. p. 96. Grev. Scot. Crypt. Flor. tab. 212, f. 2, *p.p.*; *non* Berk. Engl. Fl. v. 357.

This species has been much confused, and made to include, not only *M. juglandinum*, but *Steganosporium pyiforme*, and even *M. bicolor*, etc. But Persoon says (Obs. p. 31) "in truncis fagineis, formam ovatam exacte repraesentat . . . . septula distincta non observantur," and he shows by his figure (t. 2, f. 2) that the spores were unmistakably pyriform. He quotes, in Syn. Fung. i. 96, *S. pyriformis*, Hoffm., which is seen, however, on referring to Hoffmann, Deutsch. Flor. tab. 13, f. 2, to be another fungus.

Link, who quotes *Stilbospora ovato*, Pers. as the type of *M. ovatum*, says (pp. 89-90) "acervis sporidiorum elevatis irregulariter effusis, sporidiis maximis compactis ovalibus et pyriformibus atris pellucidis." He adds that *Stilbospora ovata*, Schmidt et Kunze n. 35, and *S. Juglandis*, Fr. Exs. n. 215 "statum primitivum sistunt," but these references are now of little value.

No doubt Link's idea was an inclusive one, but the British specimen on Beech accords exactly with his description, and is not like the other large-spored species. The name *M. ovatum* should therefore be restricted to this fungus.

The description is as follows:—

Pustules scattered, covered, flatly conical, 1-2 mm. across, then erumpent by a slit, black. Spores large, oval, but more or less attenuated at the base, *i.e.*, pyriform, translucent-black, 20-25 × 10-12 μ, agglutinated in heaps which are at first convex, then effused; sporophores long, branched.

On bark of *Fagus*, Batheaston! (*Broome*). This species is distinguished from *M. magnum* by the fact that many of the spores are decidedly pyriform, although they vary as usual towards ovoid-oblong; whenever *M. ovatum* has been recorded on *Juglans*, possibly *M. juglandinum* has been really present.

There remain now for consideration two species which have much smaller spores. The first of these has again been the subject of much confusion.

8. **Melanconium Hederae,** *Preuss*, Pilz. Hoyersw. no. 312, in Linnaea, 1855, xxvi. 717; Sacc. Syll. iii. 751.

Coniothyrium Hederae, Sacc. Mich i. 204; Syll. iii. 307.

Phoma Hederae, Desm. Pl. Crypt. no. 350.

Melanconium microspermum, Nees, Syst. Pilz. p. 32, 1817 (*quoad in Hederae*). Fckl. Fung. Rhen. no. 2106!

Stilbospora microsperma, "Pers." Auct. p.p.

The matter has here been much complicated by the fact that the issuers of exsiccata have, without knowing it, included two perfectly distinct fungi on small branches of Ivy under the same name:—one with a definite membranous pycnidium, which constitutes *Coniothyrium olivaceum*, Bon. f. *Hederae*, Sacc. (Syll. iii. 306), and the other with a thick proliferous stratum, which may sometimes extend all round the spore-containing cavity (not below only), and which bears *Melanconium*, not *Coniothyrium*, spores. The first is seen in Fckl. Fung. Rhen. no. 93!, the second *ibid.* no. 2106!

The following exsiccata have also been examined:—

"*Phoma Hederae*," Desm. Pl. Crypt. no. 350!
,, ,, Moug. et Nestl. Stirp. Crypt. no. 979!
,, ,, Berk. Brit. Fung. no. 90!
,, ,, Herb. Berk. "King's Cliffe"!
,, ,, Herb. Berk. "Norths."!
,, ,, Herb. Cooke, "Shere" (Dr. Capron), on leaves!

All these are *M. Hederae*. Dr. Capron's specimens, on ivy leaves, have a thick proliferous stratum like that at the base of a *Phomopsis*, the spores are on linear sporophores longer than themselves, and are at first colourless, small and round, afterwards becoming ovoid, brownish, 7-9 × 3-5 μ, and uniguttulate. But Fuckel's specimen, no. 93! ("*Coniothyrium olivaceum*, Bon., ad *Hederae* ramos aridos"), has a thin subglobose translucent membranous pycnidium, about 200 μ diam.; spores 4-5 × 2-3 μ, without visible sporophores. *Coniothyrium Hederae*, Sacc.

Mycoth. Ven. no. 1523!, on leaves of ivy, has similar pycnidia; but no spores could be found.

The description of the species is as follows:—

Pustules scattered, oblong or oval, 300-1000 μ long, seated in the outer cortex, covered by the blackened epidermis, somewhat prominent, black, opening by a pore or slit which afterwards becomes widely torn. Spores oval or obovoid, at first colourless, then brownish or olivaceous-black, usually 1-guttulate, 6-8 × 3-5 μ; sporophores linear, obtuse, colourless, irregular or flexuous, 15-18 × 1·5-2·5 μ.

On small dry dead stems of *Hedera Helix*, or rarely on the leaves. Common everywhere, if looked for.

Sometimes under a low magnification the black mass of spores exactly simulates an ostiolate pycnidium; on the leaves it is smaller and rounder, and more like a *Coniothyrium*, but still without a true pycnidium, only a proliferous stratum.

9. **Melanconium Pandani,** *Lév.* in Ann. Sci. Nat. 1845, iii. 66; Sacc. Syll. iii. 759; Fung. Ital. tab. 1077.

Pustules large, embedded in the bark, compound, tubercular, erumpent, black, rather thick, prominent, 1-3 mm. diam. or even more, often grouped in lines. Spores oblong-ellipsoid or somewhat ovoid, singly very pale-olive, dark-olive in mass, 5-9 × 3-4 μ, often slightly curved in profile, with one or two very minute guttules, involved in mucilage, oozing out in the form of tendrils which ultimately blacken the surface of the bark; sporophores very long, colourless, flexuose, branched.

On living bark of cultivated *Pandanus*, in Botanic Gardens, Kew, Dublin, etc. It is recorded on the Continent on the leaves also; it causes a disease which, if neglected, spreads rapidly, and soon kills the plants.

§ 2. LAMPROCONIUM.

10. **Melanconium Desmazierii,** *Sacc.* in Mich. ii. 355; Syll. iii. 751; Fung. Ital. tab. 1083.

Discella Desmazierii, B. et Br. Ann. Nat. Hist. 1850, v. 377, tab. 12, f. 8 *a*, *b*, *c*.

Discula Desmazierii, Faun. et Flor. Kew, p. 172.

Epidochium Maertensii, Westd. no. 1078.

Pustules crowded, hidden under the bark, round, depressed, occasionally umbonate in the centre, without a pycnidium, not or scarcely erumpent, black, $\frac{1}{2}$-1 mm. broad. Spores fusoid, obtuse at the ends, especially above, with a conspicious thick wall, at first quite colourless, then indigo blue, sometimes 3-guttulate, 30-36 × 6-10 μ; sporophores filiform, sometimes forked, colourless, 30-60 × $1\frac{1}{2}$ μ, rising from a thick brownish cellular stratum.

On living twigs and branches of *Tilia vulgaris*, *T. platyphyllos*, but more often on dead branches. Said to be a destructive parasite; the situation of this species in *Melanconium* is abnormal, but there seems to be no more suitable position for it than as a section of that genus. The colour of the spores can attain to a deep sea-blue; the pycnidium attributed to it by Berkeley seems to me to be non-existent.

§ 3. ECTOCONIUM.

11. **Melanconium sphaerospermum,** *Link*, Sp. Pl. ii, 1825, p. 91.

The species of *Melanconium* on the Reed-like Grasses have been misunderstood to an unusual degree. There appear to be at least two rather common forms in Europe, which resemble each other very closely, but differ slightly in the size and shape of their spores.

No. 1. has spores that in face-view appear all but perfectly circular, but when seen in profile exhibit a lens-shaped section which is in general equally biconvex, but sometimes approaches a plano-convex form, with one side flatter than the other, though always with a rather acute or somewhat flattened margin. These spores measure about 9-10 μ in diameter, by about 3-4 μ in thickness; they are dark but clear olivaceous, without guttules or granules. From the sudden change in refractive power due to the flattened margin, the dark centre, when seen in full face-view, appears to be surrounded by a paler semi-translucent zone; when seen in profile, the best-developed spores show this edge as a translucent band passing across the figure from angle to angle. They present in fact a rather close resemblance to the ascospores of *Roesleria* (*see* Ann. Bot. 1916, xxx. 412), and in a smaller degree to those of *Eurotium*.

No. 2. differs in having generally smaller spores, 6-8 μ wide, 2-2·5 μ or even 3 μ in thickness; they are also not so persistently circular, but rather ovate, subelliptic, oblong or irregular in face-view, although in profile they exactly resemble no. 1.

Both these kinds of spores are borne on short straight sporophores, which arise from a proliferous stratum or occasionally from a well-developed stroma. In both the spore-bearing stratum originates beneath the epidermis, and the spore-mass bursts through it in a long slit (or two parallel slits) and becomes effused on the surface of the matrix. The spores are at first more or less compacted like those of other *Melanconia*, but ultimately they break up to form a black pulverulent external stratum which shows no signs of its internal origin.

The apparent thickness of the lens-shaped spore depends naturally upon the angle at which it is seen; all possible widths from 2 or 3 μ up to 8 or 10 μ can often be seen in the same field.

No. 1. is *Melanconium sphaerospermum*, Link, Sp. Pl. ii. 91 (1825) = *Stilbospora sphaerosperma*. Pers. Obs. Mycol. p. 31, pl. 1, f. 6 (1796); Syn. Fung. p. 97 (1801).

No. 2. is *Melanconium Donacis*, Thüm. Contr. Myc. Lusit. no. 190! (Non *Coniosporium Donacis*, Sacc.)

But, strange to say, both these fungi have also been considered by collectors to be Hyphomycetes, of the § Dematiei, which in their advanced effused state they much resemble.

No. 1. is *Coniosporium Arundinis*, Sacc. Mich. ii. 124 (1880); Syll. iv. 243 = *Gymnosporium Arundinis*, Cord. Ic. Fung. ii. 1, tab. 8, f. 1 (1838) = *Papularia Arundinis*, Fr. Summ. Veg. Scand. p. 509 (1846).

No. 2. is *Coniosporium inquinans*, Dur. et Mont. Flor. Alger. Crypt. i. 327 (1849) = *Gymnosporium inquinans**, Berk. Plants Port. Welw. p. 7 (1853) = *Papularia Arundinis*, Sacc. Veg. Ven. Spec. p. 179, pl. 16, f. 49-51 (1873).

The following exsiccata, as well as many others in the Kew Herbarium, were examined and gave unqualified support to these conclusions:—

No. 1. *Stilbospora sphaerosperma*, Holl, Schm. u. Kunz. no. 102!, on culms and sheaths of reeds.

Melanconium sphaerospermum, Moug. et Nestl. Stirp. Crypt. no. 1258!, on *Arundo Phragmites*; Desm. Crypt. Fr. no. 326!, on *Arundo Phragmites* and other *Gramineae*; Herb. Berk. "Tansor. Northts." March, 1839!, on culms of reed.

Coniosporium Arundinis, Rab.-Wint.-Pazsch. Fung. Eur. no. 3996!, on culms of *Phragmites*; Tranz. et Serebr. Mycoth. Ross. no. 145!, on stems of *Phragmites communis*; Ell. et Ev. N. Amer. Fung. no. 2794!, on dead canes of *Arundinaria macrosperma*.

Papularia Arundinis, Herb. Cooke, "Ashmanhaugh," Dec. 1876!, on culms of reed.

No. 2. *Melanconium Donacis*, Moller, no. 97!, "ad culmos emortuos *Arundinis Donacis*," Baleia prope Coimbra, Aug. 1878.

Coniosporium inquinans, Roum. Fung. Sel. Exs. no. 4697!, on culms of *Arundo Donax*; Herb. Kew, Uganda!, on dead elephant grass (*Pennisetum*).

Coniosporium Arundinis, Herb. Kew. "Glasgow" Oct. 1911!, "on bamboo canes."

Gymnosporium inquinans, Berk. Welw. no. 20!, Portugal, on culms of *Arundo Donax*.

Papularia Arundinis, f. *platyspora, erumpens*, Sacc. Mycoth. Ven. no. 1072! and f. *microspora, superficialis*, ibid. no. 1073!, both on culms of *Arundo Donax*; Fckl. Fung. Rhen. no. 99!, on leaves and sheaths of *Phragmites*.

All the specimens classed under No. 1 have identical spores, and differ merely in age and freshness: the same is true of No. 2., but it is also evident on careful examination that no exact line of demarcation can be drawn between the two forms.

In addition to these, there is a third form, No. 3., more rarely found, it appears, in Britain. It occurs upon bamboo, and has hitherto been usually classed in herbaria as:—

Coniosporium Bambusae, Sacc. Mich. ii. 124 (1880) = *Gymnosporium Bambusae*, Bolle et Thüm. Contr. Fungh. Litor. Austr. in Boll. Soc. Adriat. iii. 432, pl. 1, f. 12 (1877).

This form differs from No. 2, of which it has the spores, only in the smaller and less elongated pustules. On the leaves of bamboo the pustules are always still smaller and rounder than on the culms, and appear more often superficial. It is no doubt the same as:—

* Berkeley's specific name was given independently. From his remarks (l.c.) he evidently was not acquainted with the existence of the earlier name.

Melanconium sphaerospermum, subspecies *Bambusarum*, Penz. et Sacc. in Malpighia, 1901, p. 238.

Conidia smaller than in the type, equally compressed, 6-8 μ diam., 3-4 μ thick, biconvex.

On culms of bamboo, Java. (*n.v.*)

The following exsiccata, among others, have been examined :—

No. 3. *Coniosporium Bambusae*, Roum. Fung. Gall. Exs. no. 936! on leaves, and no. 1198!, on culms of *Bambusa mitis*; ibid. no. 3691!, on leaves of *B. nigricans*; Sydow, Mycothec. Germ. no. 1197!, on old culms of bamboo.

Gymnosporium Bambusae, ex Herb. de Thüm., on culms of *Bambusa arundinacea*, Gorizia! (legit *Bolle*); Thüm. Mycoth. Univ. no. 885!, on the same; Ell. et Ev. N. Amer. Fung. no. 1628!, on culms of *Bambusa*; Sacc. Mycoth. Ven. no. 1287!, on leaves of *Bambusa arundinacea*.

The examination of a long series of these specimens leads (as it often does in similar cases) to the conclusion that the only logical course is to class them all as one species, with subdivisions which may be called subspecies, varieties or forms, according to taste. The occurrence of series of this kind is well-known to the working mycologist. The extreme forms may easily be considered as distinctly marked off from one another, if the intermediate forms have been unseen or ignored. As examples one may cite *Lepiota procera* and *L. rachodes*, *Boletus chrysenteron* and *B. subtomentosus*, *Poria vaporaria* and *Irpex obliquus*, *Dasyscypha nivea* and *D. virginea*. In all these cases only those who determinedly shut their eyes or vouchsafe only a cursory examination can maintain the old distinctions, which arose from insufficient breadth of knowledge. It is not a case of "lumping" v. "splitting," as in the days of the old belief in the rigidity of species. There is a third course, and as usual the golden mean is the best. The immediate adoption of such a method (which must inevitably be adopted by future generations, to save their reason!) would effect a much needed economy in the time and trouble of present day mycologists, not to speak of other naturalists. But it must be done from nature, not from books: that way chaos lies.

The appropriate classification of the forms of *Melanconium sphaerospermum* that have been found in Britain will then be :—

Sub-species 1. *Arundinis*, spores circular, 8-19 μ in diameter.

,, ,, 2. *inquinans*, spores ovoid or irregular, 6-8 μ in diameter.

,, ,, 3. *Bambusae*, spores as in 2, pustules small, less elongated.

On culms and leaves of *Phragmites communis*, *Arundo Donax*, *Bambusa*, *Arundinaria*, *Andropogon*, *Pennisetum* and similar grasses, in Europe, North and South Africa, India, Japan, Java, West Australia, and Tropical and Sub-tropical America.

It is not necessary to distinguish the forms, as Saccardo did, into erumpent and superficial; that depends almost entirely upon the age and state of preservation of the specimens; they are all similar when fresh, except perhaps those upon the leaves. It

is not necessary to distinguish the spores as flat or subglobose; they are all compressed in a similar way, although this character can be easily overlooked. Roumeguère and others have repeatedly described the spores falsely as spherical; Corda figured them nearly as they are. To ascertain this, nothing is easier than to adopt the device used by those who investigate Diatoms and Desmids, viz., by pressure upon the cover glass to cause the spores to roll over and over (in a sufficient depth of water). Then one sees a single mature spore exhibit all the phases that might be supposed to be shown by a very oblate Saturn, if the planet could be treated in such a disrespectful way.

It would be idle to speculate as to the cause that determines which of the three sub-specific forms the fungus shall assume: it may be the age, size, or vigour of the host, it may be the favourableness or unfavourableness of the season at the time of growth. Experiment alone can settle this question: only one thing is certain, it is not the species or genus of the host alone. There is, however, strong reason for believing that, when the subspecies *Bambusae* is found in this country, as it often is, on bamboo sticks in gardens, it was imported in an undeveloped state on the canes, and merely became effused when they were left in the damp ground here.

Besides the forms mentioned above, there are two others closely allied, but possibly distinct, not yet found in Britain.

One is *Coniosporium rhizophilum*, Sacc. Mich. ii. 124 = *Gymnosporium rhizophilum*, Preuss, in Linnaea, 1851, xxiv. 102, which is recorded on dead rhizomes of *Triticum repens*, *Agrostis* and *Cynodon* on the Continent, and should also occur in this country. It does not seem to differ from *M. sphaerospermum* sub-sp. 2, but in the absence of good specimens that point cannot be decided. The only exsiccatum seen, and that a very poor one, is *C. rhizophilum*, Sydow, Mycoth. Germ. no. 149!, on ploughed up rhizomes of *Triticum repens*. This has the spores of *inquinans*: some other exsiccata under the same name were chiefly *Epicoccum*.

The other is *Coniosporium circumscissum*, Sacc. Syll. iv. 244 = *Gymnosporium circumscissum*, B. et Br. Fung. Ceyl. no. 811. This also has the spores of *inquinans*, but differs in the shape of the pustules. It is, however, certainly congeneric with the others, and may be described as:—

Melanconium circumscissum, *Grove.* Pustules oblong, 0·5-1 mm. long, smaller and more compact than in *M. sphaerospermum* sub-sp. *Arundinis*, and differing from that in splitting in a circumscissile manner. Spores 6-7 × 2-2·5 μ, shaped exactly as in *M. sphaerospermum* sub-sp. *inquinans*.

On culms of bamboo, Peradeniya, Herb. Berk. no. 1050!; on dead bamboo canes, Philippine Islands, Herb. Govt. Labor. no. 37!

In this sub-species the epidermis over the pustules splits not only in two parallel lines, placed longitudinally on the cane, (as often occurs in *M. sphaerospermum* sub-sp. *Arundinis*), but also splits across transversely at each end, thus completing the

severance of a portion of it, which then falls off as a lid, much after the style of *Stegia Ilicis*, but oblong not round in shape. In the Ceylon specimen the "lids" are still present; in the more advanced one from the Philippines they have all disappeared and the fungus looks quite superficial. Occasionally similar states can be seen in examining specimens of *M. spherospermum* sub-sp. 3, on bamboo canes. In fact, no. 5 forms a link between nos. 2 and 3. Therefore both the above-mentioned might conveniently be classed under the same head, and a truer representation of the facts would probably be:—

Sub-species 1. *Arundinis.*
,, 2. *inquinans.*
,, 3. *Bambusae.*
,, 4. *rhizophilum.*
,, 5. *circumscissum.*

In addition to all these, there are others which present greater differences. One group is distinguished by its much larger spores. To this belongs *Melanconium arundinaceum*, Ell. et Ev. in Bull. Torr. Bot. Club, 1897, xxiv. 290, which is described as follows:—

"Pustules gregarious, elliptical, about 1·5 × 1 mm., lens-shaped, covered by the lead-coloured epidermis which finally splits along the middle. Spores globose, 15-20 μ diam., or ellipsoid, 18-22 × 13-16 μ; sporophores shorter."

"On dead canes of *Arundinaria*, Louisiana."

It will be noted that nothing is said about compression of the spores, a point which certain observers have persistently overlooked: in the absence of specimens, however, this point cannot be settled. But there is another described species, *M. saccharinum* Penz. et Sacc. in Malpighia, 1901, p. 238, on dead or dying leaves of *Saccharum officinarum* in Java, which is stated to be very similar to *M. arundinaceum*, but having the spores globose-compressed, 24 μ wide, 14 μ thick; this suggests unmistakably that the spores of *M. arundinaceum* are also compressed, and that *M. saccharinum* is its leaf form, and possibly parasitic.

Several other species on bamboo have been described, differing in certain details, but of these also no specimens are available, viz.:—

M. (?) *bambusinum*, Speg. (Sacc. Syll. x. 474).
M. hysterinum, Sacc. (,, ,, xi. 572).
M. Shiraianum, Syd. (,, ,, xvi. 1009).

The latter, which is apparently = *Coniosporium hysterinum*, Bubák (Sacc. Syll. xviii. 564), is hardly different from *M. sphaerospermum* sub-sp. *Bambusae*; nor the two former from *M. arundinaceum*. One cannot but believe that all these confused species, impinging upon one another at so many points, could be reduced to a much smaller number by critical examination of the actual specimens, but without these it is only possible to call

attention to the probabilities of the case. The habit of giving cursory and incomplete descriptions of "new species" of fungi (unaccompanied by figures) has survived from the time of Persoon and Link, and is to blame for an extensive waste of space in many mycological publications.

So far there has been hardly a single indication that these forms are other than saprophytic. But quite recently Turconi has published a paper "On a New Malady of Bamboo" (Sopra una nuova malattia dei bambù) in Atti Real. Accad. Lincei, Rendic. 1916, xxv. p. 528. This account is amplified in Atti Istit. Bot. Pavia, 1916, xvi, p. 245, pl. 18. In these Turconi states that, in the summer of 1914, a grave disease affected a plantation of *Bambusa mitis* at Pavia. On the diseased culms there were found two fungi which he names *Melanconium Bambusae* sp.n. and *Scirrhia Bambusae*, sp.n.; he considers the former to be a conidial stage of the latter, and he proved by experiment that the disease could be transferred, not only to healthy *B. mitis*, but also to *B. gracilis* and *B. nigra*. The infection was made both by the natural spores, and by the mycelium obtained by cultures from the spores. Attempts to infect *B. arundinacea* gave negative results. The description of the *Melanconium* stage shows that it is practically identical with *M. saccharinum*, Penz. et Sacc., mentioned above, but if so Turconi, like many other mycologists in similar cases, failed to notice that the spores were compressed.

EXCLUDED SPECIES.

Melanconium Rusci, Cooke et Mass. in Grevill. xvii. 3. Sacc. Syll. x. 473.

"Pustules scattered, orbicular, erumpent, covered by the lacerated brown cuticle. Conidia elliptical, continuous, sooty-olive, $12 \times 7\text{-}8$ μ.

"On phyllodes" [sic] "of *Ruscus aculeatus*, Kew. This cannot be a form of *Sphaeropsis Rusci*, for there is no perithecium and the pustules are scattered and solitary" (C. & M.)

An indubitable error: whatever the specimens may have been, they are not a *Melanconium*, and apparently not a fungus at all.

Explanation of Figures.

1. *Melanconium bicolor*, on Birch; *a*, two spores of *D. profusum* (Grev.).

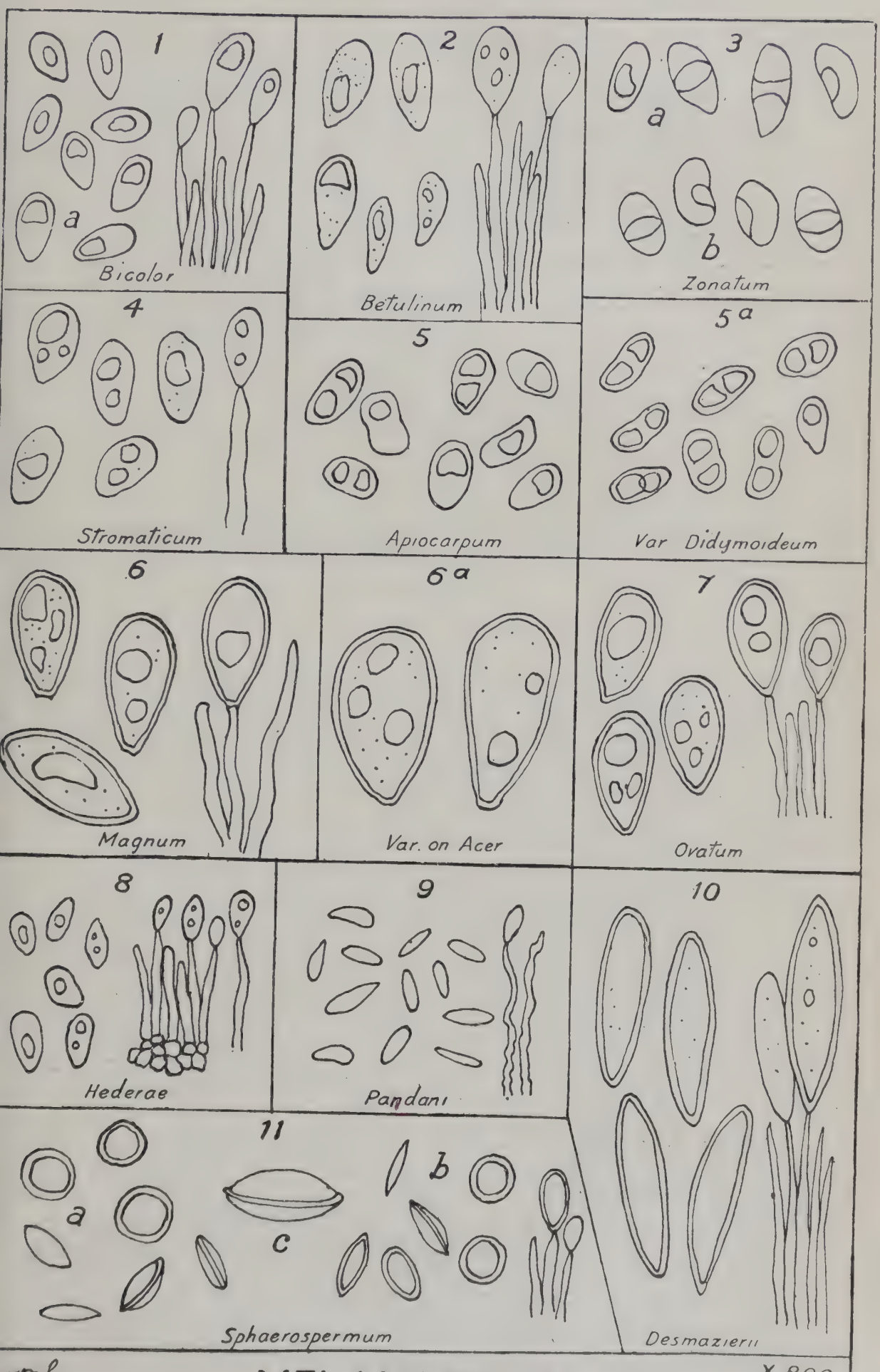
2. *M. betulinum*, on Birch.

3. *M. zonatum*; *a*, from J. B. Ellis's specimen on *Ostrya*.
   b, from Berkeley's specimen, no. 1574.

4. *M. stromaticum*, on Hornbeam.

5. *M. apiocarpum*, on Alder.

5*a*. ,, , var. *didymoideum*, from J. W. Ellis's Bridgnorth specimen.



MELANCONIUM

X 800

6. *M. magnum*, on Walnut.

6*a*. ,, , var. on *Acer*, U.S.A.

7. *M. ovatum*, on Beech, from the Batheaston specimen.

8. *M. Hederae*, on Ivy.

9. *M. Pandani*, on Screw Pine.

10. *M. Desmazierii*, on Lime.

11. *M. sphaerospermum*; *a*, on *Phragmites*.
b, on Bamboo cane.
c, diagrammatic view of a typical spore.

All the figures, except 11*c*, × 800 times.

XV.—NOTES ON AFRICAN COMPOSITAE: V.

J. Hutchinson.

Hippia, *Linn.*

The genus *Hippia* is distinguished from other South African members of the tribe *Anthemideae* by its alternate mostly divided or toothed leaves, epaleaceous receptacle, discoid heterogamous flower-heads, with the marginal flowers female and very much reduced, and the male flowers well developed but sterile, with 5-lobed corollas. There is no indication of a pappus in any of the species, but the flat achenes when dry have a submembranous border which is no doubt an adaptation for wind dispersal. One or two resemble certain species of *Cotula*, which genus differs in having 4-lobed male corollas with flattened or winged tubes. Observations on the pollination of the flowers would no doubt prove interesting, for in many of the female flowers examined the minute reduced corollas appear as if they had slightly increased in size after fertilisation, at the same time perhaps becoming somewhat mucilaginous and entirely covering the styles. The fertile achenes appear to be nearly mature by the time the male flowers in the same head begin to open.

Hippia is confined to South Africa and occupies a rather restricted area of the South Western Region from the Cape and Tulbagh Divisions in the west to Humansdorp in the east. The larger species, especially *H. frutescens*, bear considerable resemblance to the boreal *Tanacetum*, of which the genus might be regarded as an extreme reduction. Indeed, the reduction in *Hippia* has gone about as far as can be supposed possible in the *Compositae*. This is shown clearly by the few bracts, epaleaceous receptacle, bisexual flowers, the males abortive, the extremely reduced female corollas and the dorsally flattened epappose achenes.

CLAVIS SPECIERUM.

Folia integra vel plerumque bi-vel tridentata, sessilia... ... ... 1. *integrifolia.*
Folia profunde trilobata, imbricata ... ... 2. *trilobata.*
Folia pinnatilobata vel pinnatisecta, rarius etiam trilobata:—
  Foliorum segmenta utrinsecus 1–2, lamina basin versus in petiolum angustissimum attenuata; achaenia dense pilosa ... ... 3. *Bolusae.*
  Foliorum segmenta utrinsecus 3–8, lamina sessilia vel leviter petiolata:—
    Foliorum segmenta triangularia vel ovato-triangularia; achaenia glabra ... ... 4. *hirsuta.*
    Foliorum segmenta linearia vel oblanceolata:—
      Rami graciles, plerumque decumbentes vel subascendentes; folia usque ad 2 cm. longa, pilosa; achaenia scabrido-papillosa ... . 5. *pilosa.*
      Rami satis robusti, erecti; folia brevissime pubescentia, 2–4·5 cm. longa; achaenia glabra ... ... 6. *frutescens.*

Leaves and floral details of *Hippia*; the numbers correspond with those of the species in the text.

1. **H. integrifolia**, *Less.* Synop. Composit. 268 (1832); DC. Prodr. vi. 144; Harv. in Harv. et Sond. Fl. Cap. iii. 171.

Descr. ampl.—*Caules* diffusi, elongati, dense foliati, villoso-pilosi. *Folia* sessilia, reflexa, obvato-oblanceolata, bi-vel tri-

dentata vel rarius integra, 1-1·5 cm. longa, 3-8 mm. lata, dense hirsuta, glandulis aurantiacis sessilibus ornata, demum minute foveolata. *Capitula* pauca, in cymas breves disposita, breviter pedunculata, pauciflora. *Involucri bracteae* 3-seriatae, exteriores 3-4, oblongo-ovatae, subacutae, 2·5 mm. longae, 1·75 mm. latae, 1-nerviae, longe ciliatae, intermediae obvatae, 3·5 mm. longae, dorso pilosae, margine pectinato-ciliatae, interiores circiter 5, spathulatae, dentatae, ciliatae, 3 mm. longae. *Corollae tubus* 1·5 mm. longus, a basi cylindrico late expansus, extra glandibus sessilibus ornatus, lobi lancealato-ovati, subacuti, 0·75 mm. lati. *Antherae* 0·75 mm. longae. *Achaenia* matura non visa.

South Africa.—South Western Region: Swellendam; Mt. Peak near Swellendam, Jan., *Burchell* 7297; "Cape," Vahl; *Ecklon & Zeyher.*

As there is no authentic example of this species at Kew, I have described Burchell's plant in more detail than may be found in Lessing's original. The identity of *Burchell* 7297 with Lessing's *H. integrifolia* has been very kindly confirmed by Prof. Dixon, of Dublin, where a type specimen is preserved. According to Harvey there are also specimens in the Sonder and Cape Herbaria.

2. **Hippia trilobata,** *Hutchinson,* sp. nov.

Caules diffusi, graciles, dense foliati, minute puberuli. *Folia* sessilia, reflexa, ad medium trilobata, basi cuneata, 5-7 mm. longa, 3-7 mm. lata, tenuiter chartacea, infra longe pilosa et nigro-punctata. *Capitula* terminalia, solitaria, sessilia, foliis superioribus circumdata. *Involucri bracteae* subfoliaceae, ovatae, 2·5-3 mm. longae, villosae. *Flores* desunt.

South Africa.—South Western Region: Riversdale; Kampsche Berg, shady sides towards the summit, Dec. 1814, *Burchell* 7092.

I have not been able to find any flowers on Burchell's otherwise very good specimen. The affinity is so clear with *H. integrifolia*, Less., that in spite of their absence I have thought it worth while describing.

3. **H. Bolusae**, *Hutchinson* in Ann. S. Afr. Mus. ix. pt. vi. 394, fig. 7.

South Africa.—Karroo Region: Ceres; fissures of rocks at Mitchell's Pass, about 600 m., Oct., *Bolus* 2612*; *Pearson* 3534. Worcester; mountains above Worcester, *Rehmann* 2662.

A very neat and beautiful little plant which reminds one very much of the tiny leaved *Helxine Soleirolii*, Req., so familiar now as an edging to stages in English greenhouses. This species might very well be suitable for the same purpose.

4. **H. hirsuta**, *DC.* Prodr. vi. 144 (1837); Harv. in Harv. et Sond. Fl. Cap. iii. 171.

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* Erroneously cited in Ann. S. Afr. Mus. l.c. as no. 2616.

South Africa.—South Western Region: Riversdale; in moist places about the waterfall at Garcias Pass, Dec., *Burchell* 6981 (type).

5. **Hippia pilosa**, *Hutchinson*, comb. nov.

Tanacetum pilosum, Berg. Cap. 244 (1767). *T. cotuloides*, Linn. Mant. 282 (1771). *Cotula fimbriata*, Spreng. Neue Entdeck. iii. 41 (1822). *Hippia gracilis*, Less. Synop. Comp. 268 (1832); Harv. in Harv. et Sond. Fl. Cap. iii. 170, incl. var. *repens*, Harv. l.c. 171; Bolus et Wolley-Dod in Trans. S. Afr. Phil. Soc. xiv. 283. *H. repens*, DC. Prodr. vi. 144 (1837). *H. cotuliodes*, O. Kuntze, Rev. Gen. Pl. iii. ii. 159 (1893). *Tanacetum laciniatum, foliis super. trifidis*, etc., Vaill. Act. Paris, 1719, 337.

South Africa.—South Western Region: Cape; Table Mt., Nov. *Ecklon* 787; top of Skeleton Ravine, Aug., *Wolley-Dod* 2947; south slopes of Klaasjagersberg, Aug., *Wolley-Dod* 1502; lower slopes of Table Mt., among rocks, 700 m., Sept., *Bolus* 3938; Newlands, Sept., *Wilms* 3378; Simons Bay, *Wright;* damp places on Table Mt., *Milne* 74; *MacGillivray* 525; *MacOwan* 122. Worcester; Dutoits Kloof, 2000 m., Oct.-Jan., *Drège a.* Caledon; Zwart Berg, near the Hot Springs, 300-650 m., Aug., *Zeyher* 2837; *Pappe;* Genadendal, 1000-1300 m., *Drège a.* Swellendam; mountain peak near Swellendam, Jan., *Burchell* 7305. Riversdale: Garcias Pass, bushy shrub on mountain slopes, Sept., 1908, *Phillips* 359. Oudtshoorn; Zwartberg Pass, 1700 m., Dec., *Bolus* 12020.

6. **H. frutescens**, *Linn.* Mant. 291 (1771); Thunb. Fl. Cap. ed. Schult. 723; DC. Prodr. vi. 144; Harv. in Harv. et Sond. Fl. Cap. iii. 170. *Tanacetum frutescens*, Linn. Sp. Pl. 1183 (1763).

South Africa.—South Western Region: Tulbagh; banks of streams below Winterhoek, Sept., *Thunberg*; Saron, 800 m., Oct., *Schlechter* 10686, 10689. Paarl; Paarl Mt., damp places 1000-2000 ft., Aug.-Oct., *Drège a*; Paarl Klip, Oct., *Bolus* 3169. Swellendam; *Zeyher*. George; near Lange Valley, Aug., *Burchell* 5700; near George, *Burchell* 6039. Knysna, between Knysna and the mouth of the Knysna River, July, *Burchell* 5513; Ruigte Valley, below 160 m., Sept., *Drège b*; Plettenbergs Bay, Mar., *Mund* 81. Humansdorp; north side of Kromme River, near Wagenboom Station, Mar., *Burchell* 4869. "Cape," *Thom* 4; 986. Cultivated in France in 1821 (Herb. Gay).

XVI.—WOOD PRESERVATION.

W. Dallimore.

The application of various chemicals of a preservative character to wood has for many years played an important part in timber economy, and users of large quantities of wood are keenly alive to the necessity of availing themselves of every possible means of prolonging its period of usefulness.

Preservatives are applied to timber for one or more of several objects, i.e., to render it less susceptible to attacks from parasitic fungi; to make it as far as possible waterproof; to preserve it and at the same time improve its appearance; to prevent or check the ravages of boring insects and other forms of animal life and to render it less inflammable.

In some instances one application may suffice for two or more of these objects, for chemicals are available that are poisonous alike to fungi and insects, or which possess both antiseptic and water-proofing properties.

The chief danger to unprotected wood in temperate countries must be anticipated from parasitic fungi for mycelium of certain species may be present in the timber when it is felled or purchased; whether or not, there are always spores floating about in the atmosphere which are a source of danger to wood upon which they may fall. For some time the presence of spores or mycelium may pass unnoticed, but directly conditions arise which favour development, growth becomes active and signs of decay or breaking up of the wood tissues are soon seen. If, however, the conditions are unfavourable to fungus growth, the spores and mycelium will probably remain dormant or die. For this reason timber that is to be utilised for positions favourable to fungus growth should be rendered as far as possible proof against fungus attacks by the application of an agent which is poisonous to such lowly forms of plant life.

Soft woods in contact with the ground are very liable to attacks by fungi and they soon decay if not protected in some way. Railway sleepers of yellow deal, laid in their natural state, would often be useless at the end of a year or two, but treated with a preservative they remain sound for 12 or 15 years or even longer. Telegraph and telephone poles as brought from the forest would decay in a very short time, but after the removal of the bark and treatment with a preservative they will last for many years. Paving blocks of Scots pine would not be worth laying as cut from the log, but when treated with an antiseptic, laid on a proper foundation and coated with a waterproof covering, they frequently wear well for a dozen years or more even where traffic is heavy. Thinnings from young plantations have often little value in a natural state owing to the large proportion of sap wood which is peculiarly liable to decay, but after proper immersion in creosote, they can be profitably utilised for fencing and other purposes. Sheds and farm buildings constructed of preserved timber are yearly becoming more popular, but it appears that a good deal more preserved timber might be used for such work.

Fence timber deserves special attention and no post ought to be placed in the ground that has not had at least the lower part treated with an antiseptic. The weakest part of a post is that about the ground line or, roughly, the portion occurring 9 in. above and 9 in. below the ground level, a point often described as "between wind and water." This section is constantly exposed to moisture from the soil and to the drying effects of the air but can never become as dry as the more exposed parts,

neither is it in such an equable state of moisture as the deeply buried portion from which air is excluded. Decay usually begins about, or just below, the surface of the soil and quickly spreads for a few inches upwards and downwards. This condition is often very noticeable in suburban districts where gardens are separated by wood fences. Unprotected deal posts are used for cheapness, the exposed parts being coloured by a thin tar oil, and the buried parts left in the natural state. After a couple of years or so the posts rot and break off at the ground line. Some hardwoods such as oak, false acacia (*Robinia*), and elm, stand well for a number of years, but as a rule well-preserved soft woods outlast unpreserved hard woods, therefore the most susceptible parts of posts should be rendered poisonous to wood-destroying fungi even if the whole cannot be treated.

Before, however, subjecting woodwork to preservative treatment it should, in most cases, be properly worked and be quite ready for fitting into place both for effectiveness and economy, for it must be remembered that the antiseptic solution cannot be depended upon to soak thoroughly into the centre of thick sections and any untreated wood exposed by subsequent working may be attacked by fungus; at the same time it is only profitable to preserve such wood as will eventually be utilised.

Preservation of wood against fungus attacks may be effected by means of oily or watery solutions. The oily substances are usually heavy tar oils or sometimes petroleum, or those oils may be mixed with another substance. The commonest and most popular antiseptic in this country, apart from ordinary paints, is dead oil of tar, commonly, but erroneously, called creosote, which may be applied cold but is more often injected in a heated condition under considerable pressure. The watery solutions usually contain certain salts such as zinc-chloride, bi-chloride of mercury, copper sulphate, &c., but sugar and various other substances may be dissolved in water and injected into timber. Several proprietary mixtures can also be procured for the purpose.

When the treated wood is to be exposed to moisture a certain amount of water-proofing is desirable, and with that in view the oils and the proprietary mixtures with oil as a base, are preferable to watery solutions, for the salts may leach out through excessive damp.

In most cases seasoned wood is more amenable to treatment than unseasoned, although in one or two instances, the copper sulphate method of preserving in particular, the chemical must be introduced as soon after the trees are felled as possible and before the removal of the bark. This is one instance in which it is not possible to work the wood before impregnation.

To preserve wood against the attacks of insects and marine borers it is necessary to make it poisonous to animal life or to render it objectionable in some other way. Highly scented woods as a rule are less subject to injury by insects than those that are inodorous and in some instances good results have followed after dressing unscented wood with cedar oil. The majority of the substances used to safeguard wood from fungus attack also render it poisonous to insects, whilst piles and wharf timbers thoroughly

impregnated with heavy tar oils are better able to withstand the attacks of marine borers than timber prepared in any other way. The progress of decay in furniture and other woodwork brought about by the presence of the larvae of beetles or other insects may be checked or stopped by killing the larvae in the wood. This can be done by heating the timber or by soaking it in a solution of carbolic acid or corrosive sublimate. It is also possible to kill larvae by placing the infested wood in a closed room or retort and exposing it to the fumes of bi-sulphide of carbon. Considerable good can also be done by applying the liquid with a painter's brush, taking care to fill all the holes. It must, however, be remembered that the substance is highly inflammable. Carbon tetrachloride mixed with a little cedar oil or naphthalene may also be applied to insect-infested wood with good results. It should be noted that any of these substances applied to polished wood destroy the polish. Bamboos used in a natural state in some tropical countries are soon ruined by beetles, but in India, after being thoroughly soaked in water, they are found to be resistant to their attack. The reason is not clear, but it may be that the water makes the stems distasteful or that larvae may be present in small numbers in the green stems which multiply very rapidly as they dry, whereas, by first soaking the bamboos in water the larvae are drowned.

Many substances have been employed for the purpose of rendering wood less inflammable, borax and salts of ammonia being amongst the most satisfactory.

It is not the intention in this article to describe fully the various means employed for preserving wood from any of the destructive agencies referred to but to pass in review some of the more important contributions to the subject from which full details can be gleaned by anyone interested in the work.

The most important work recently published in this country is a book entitled "The Preservation of Wood," by Mr. A. J. Wallis-Tayler.* It is really an elaboration of a lecture given by the author before the Royal Society of Arts, early in 1914, which was printed in the Society's Journal for Feb. 20th of that year. The book commences with a chapter on the history of wood preservation, followed by a chapter on the destruction of wood by decay and the ravages of insects, marine worms, &c. There is then a chapter on seasoning and drying with various tables and diagrams showing moisture contents, &c., of different kinds of woods. Natural air seasoning, seasoning by steam, water seasoning, artificial seasoning or drying by heat (hot air), drying or seasoning by natural air circulation, drying or seasoning by oxygen, drying or seasoning by smoke, drying or seasoning by scorching or charring, drying or seasoning by electricity, effect of time on the strength of wood and the effect of moisture on the strength of wood are the sub-headings of this chapter.

The preservative treatment of wood occupies chapters iv.-ix. Chapter iv. deals largely with the structure of wood, conditions essential to success, and the absorptive properties of various woods.

* Published by William Rider & Son, Limited, Paternoster Row, London E.C.; 344 pp., with more than 100 illustrations and numerous tables.

Chapter v. deals principally with the open tank system of preservation, the various methods being described with illustrations of the apparatus required. The more elaborate pressure system of impregnation is described in chapter vi., full particulars being given of the various processes adopted with green and seasoned wood, temperatures, pressure, descriptions of retorts and appliances with numerous illustrations of plant and capacity tables.

The principal processes with dead oil of tar, commonly called creosote, or with dead oil of tar as a base, are described in chapter vii. These are:—The Dead Oil of Tar, Bethel, or Creosoting Process. The Rueping Process. The Lowry Process. The Curtis-Isaacs Process. Processes wherein creosote is used in conjunction with some other agent are:—The Zinc-creosote, Rutger or Card Process. The Allardyce Process. The Creo-resinate Process.

Chapter viii. deals with preservation by means of various salts and other substances, the preservative agents and processes being as follows:—The Bichloride of Mercury Process or "Kyanizing." The Zinc-chloride Process or "Burnettizing." "Burnettizine." The Zinc-tannin or Wellhouse Process. The Boucherie Process. The Hasselmann Process. The Vulcanizing or Haskinizing Process. The Saccharine Solution or "Powellizing" Process. The Guissani Process. The Cresol-calcium Process. The Aczol Process. The Naphthalene Process. The use of Natural Oils as Preservative Agents.

This is followed by a chapter on various proprietary and other preservative solutions, the subjects described being:—Anthrol, Atlas, Bellit, Carbolineum, Dyphenin, Green Oil, Hylinit, Jodelite, Microlineum, Microsol, Sideroleum, Solignum, Sotor, Stoprot, Wilcoo, &c.

An account of the absorption limit and life of preserved wood is given in chapter x. The fire-proofing and fire-retardent treatment of wood is the subject of chapter xi. The cost of the various methods of treatment is discussed in chapter xii. and that is followed by an appendix of 38 pages given to formulae, tables, and memoranda on various subjects connected with the preservation of wood, the book being ended by a good index of 14 pages.

Although less comprehensive than the foregoing work the following are exceedingly useful as being in most instances the results of special studies upon definite branches of wood preservation:—"Treated Wood-block Paving," by W. G. Mitchell, M.Sc., Bulletin 49, Forestry Branch, Department of the Interior, Canada, pp. 1-40, illustrated. In this bulletin the author deals very fully with the impregnation of street paving blocks and with laying wood pavement, comparing the methods in various countries. A bibliography of works upon wood pavement, creosote oils and impregnation is also given.

"A Visual Method for Determining the Penetration of Inorganic Salts in Treated Wood," by E. Bateman, pp. 1-5, Forest Service Circular, 190, U.S. Department of Agriculture. In order to show the depth of penetration by an inorganic salt such as zinc chloride, solutions of potassium ferrocyanide and uranium

acetate are applied to newly-cut surfaces of wood and the penetration line is shown by the colour reaction.

"Volatilization of Various Fractions of Creosote after their Injection into Wood," by C. H. Teesdale, pp. 1-5, Forest Service Circular 188, U.S. Dept. of Agric.

"The Absorption of Creosote by the Cell Walls of Wood," by C. H. Teesdale, pp. 1-7, Forest Service Circular 200, U.S. Dept. of Agric. A record of certain tests carried out at the Forest Products Labratories.

"Commercial Creosotes with Special Reference to Protection of Wood from Decay," by Carlile P. Winslow, pp. 1-38, Forest Service Circular, 206, U.S. Dept. of Agric. A considerable amount of information upon the various grades of commercial creosotes is presented in this paper, their different constituents being represented by diagrams and tables.

"The Preservative Treatment of Loblolly Pine Cross-arms," by W. F. Sherfesee, pp. 1-29, Forest Service Circular 151, U.S. Dept. of Agric. This is a record of experiments in grading, seasoning and creosoting certain classes of wood. The experiments were conducted with 14,000 cross-arms fresh from the forest, the object being to devise a plan or process which would insure a uniform, efficient and cheap impregnation. Before treatment the arms were graded into three groups according to the quantity of sap and heart wood present. The processes of seasoning and impregnation adopted are given in detail. It was found that air-dry sap wood could be thoroughly saturated with warm creosote at about 125° F. to 140° F., without pressure, but that to saturate heart wood, pressure was necessary. It was also found that the creosote was afterwards more easily withdrawn from the cells of sap wood than from heart wood. The results indicate that sap wood should be allowed to retain 10 lbs. of oil per cubic foot, whereas in heart wood 6 lbs. will suffice. Perfectly green timber subjected to the same process as dry sap wood took up 2·2 lbs. per cubic foot during the time that dry sap wood took up 12·6 lbs. per cubic foot. The results of the experiments indicate how a considerable saving of oil can be made.

"Experiments on the Strength of Treated Timber," by W. Kendrick Hatt, Ph.D., pp. 1-31, Forest Service Circular 39, U.S. Dept. of Agric. The physical characteristics and strength of timber treated with zinc-chloride and creosote are discussed in this circular. The conclusions arrived at appear to be—1. That a high degree of steam is injurious, the limit of safety for loblolly pine being 30 lbs. for 4 hours or 20 lbs. for 6 hours. 2. The presence of zinc-chloride will not weaken wood under static loading, although the indications are that the wood becomes brittle under impact. 3. The presence of creosote will not weaken wood of itself. Since apparently it is present only in the openings of the cells, and does not get into the cell walls, its action can only be to retard the seasoning of the wood. Various tables are given showing methods employed in the treatment of the wood with the results.

"Experiments with Railway Cross-ties," by H. B. Eastman, pp. 1-21, Forest Service Circular 146, U.S. Dept. of Agric. The

experiments undertaken in this case were to determine. 1. The green weight and rate of seasoning of timbers cut in different months. 2. The absorptive power of seasoned timber cut in different months. 3. The comparative durability of green, seasoned, and treated timbers when laid under similar conditions with different kinds of tie plates and rail-fastenings in a test track. The woods under experiment were *Pseudotsuga Douglasii* (Douglas Fir), *Larix occidentalis* (Western Larch), *Tsuga Albertiana* (Western Hemlock), and *Thuya plicata* (Canoe Cedar).

"The Estimation of Moisture in Creosoted Wood," by Arthur L. Dean, pp. 1-7, Forest Service Circular 134, U.S. Dept. of Agric.

"The Seasoning and Preservative Treatment of Hemlock and Tamarack Cross-ties," by W. F. Sherfesee, pp. 1-31, Forest Service Circular 132, U.S. Dept. of Agric. This deals with seasoning of timber and impregnation with zinc-chloride under various conditions. The results of the investigations appear to indicate that unseasoned timber of these species should not be subjected to injection, that close-grained wood is not easily treated and that hemlock ties that weigh more than 40 lbs. per cubic foot and tamarack ties which weigh more than 42 lbs. per cubic foot should not be subjected to impregnation. It was also found that better results were obtained by treating the two woods separately than by mixing them in the same charge.

"Prolonging the Life of Mine Timbers," by John M. Nelson, pp. 1-22, Forest Service Circular 111, U.S. Dept. of Agric. Experiments were conducted with various kinds of mine timber under brush, open tank and pressure treatment. Oil of creosote, carbolineum, salt solution, and zinc chloride were used.

"Preservative Treatment of Poles," by William H. Kempfer, pp. 1-55, Forest Service Bulletin 84, U.S. Dept. of Agric. In this bulletin the results of different kinds of treatment of various woods used for telegraph and telephone poles are discussed. Numerous illustrations are given. See also Circular 103, Seasoning of Telephone and Telegraph Poles; Circular 104, Brush and Tank Pole Treatment; and Yearbook of the Department of Agriculture, U.S.A., Prolonging the Life of Telephone Poles.

"Cross-tie Forms and Rail Fastenings with Special Reference to Treated Timbers," by Hermann von Schrenk, pp. 1-70, Bulletin 50, Bureau of Forestry, U.S. Dept. of Agric. In this bulletin the advantages and disadvantages of various ways of sawing logs, seasoning, impregnation, and the laying of sleepers are dealt with. The work is well illustrated.

"The Open-tank Method for the Treatment of Timber," by Carl G. Crawford, pp. 1-15, Forest Service Circular 101, U.S. Dept. of Agric. This deals with the open air treatment of timber.

"Condition of Experimental Chestnut Poles in the Warren-Buffalo and Poughkeepsie-Newton Square Lines after Five and Eight Years' Service," by Carlile P. Winslow, pp. 1-13, Forest Service Circular 198, U.S. Dept. of Agric.

"Service Tests of Ties," by Howard F. Weiss, pp. 1-25, Forest Service Circular 209, U.S. Dept. of Agric. Particulars are given of sleepers of various kinds of woods impregnated with different preservatives.

"Report of the Use of Metal Railroad Ties and on Preservative Processes and Metal Tie Plates for Wooden Ties," by E. E. Russell Tratman, A.M., Am. Soc., C.E., pp. 1-363, Bulletin 9, Division of Forestry, U.S. Dept. of Agric. A great deal of information concerning wood preservatives and methods of treatment are given in this work.

"The Manual of Forestry," by Sir W. Schlich, and "The Forester," by James Brown and John Nisbet, both published in this country, also devote space to the principal methods of preserving timber.

"Creosoting of Sleepers," Indian Forester, July, 1914. A Report on creosoting Spruce, Silver Fir, Chil Pine, and Blue Pine, by Millars' Timber and Trading Company, Ltd.

"Note on the Antiseptic Treatment of Timber with special reference to Railway Sleepers," by R. S. Pearson, Imperial Forest Service, Indian Forest Records, vol. iii. pt. ii. 1912, pp. 1-107. This comprehensive work deals with the numerous methods of impregnating timber with antiseptics, paying special attention to Indian woods and particularly to those likely to be of value for sleepers. The various processes are described, and an idea is given of their relative value and cost. Solignum as a preventive of attacks by white ants is recommended, and on p. 82 the following remarks of the Imperial Entomologist at Puna, after experiments with the substance, are quoted:—"Solignum has given the best results of any white ant preservative on wood that I have yet tested, and was effective in stopping the entrance of white ants to a pucca building in which they were doing damage." Details of experiments, with the results, conducted with various kinds of timber exposed to the attacks of white ants are given. The article is of value to all who are interested in wood preservatives and particularly to those resident in the Tropics.

"Note on Ligno Protector as a possible means of Preventing Timber from Splitting while Seasoning," by R. S. Pearson, Forest Bulletin 13, 1913, pp. 1-12, Imperial Forest Service, India. The results of the experiments do not appear to have been conclusive.

"Preservative Treatment of Timber for Estate Purposes," by J. F. Annand, M.Sc., Quarterly Journal of Forestry, vol. viii., July, 1914, pp. 169-186. This paper deals with numerous experiments with saponified creosote and naphthalene by the open-tank method of impregnation.

"The Rueping Method of Creosoting," by W. P. Greenfield, Quarterly Journal of Forestry, vol. x., January, 1916, pp. 29-36. An article giving a good description of one of the special methods of impregnating timber with creosote.

"Increasing the Durability of Timber," by William Somerville, M.A., D.Sc., Journal of the Board of Agriculture,

vol. xviii. No. 4, July, 1911, pp. 281-287. Creosote is the principal substance dealt with in this article.

"A Note on the Preservation of Bamboos from the attacks of the Bamboo Beetle or Shot-Borer," by E. P. Stebbing, F.L.S., Forest Pamphlet 15, pp. 1-18, Imperial Forest Service, India, Various experiments are recorded and as a result it is recommended that bamboos be soaked for five days in water, and after drying that they be soaked for 48 hours in common Rangoon oil.

"Toxity of Various Wood Preservatives," by C. J. Humphrey and Ruth M. Fleming, report in the Journal of Industrial and Engineering Chemistry, vol. vi., 1914, p. 128. This article deals with the properties and killing point of various preservatives and is the result of investigations conducted in the Forest Labratory, Madison, Wisconsin. The subjects dealt with include:—Wood tar (hardwood), wood tar (Douglas fir), spiritine wood preserver, water gas tar creosote, coal tar creosote, avenarius carbolineum, S. P. F. carbolineum, C. A. wood preserver, Holzhelfer, No. 2097, copperized oil, fuel oil, kerosene, cresol-calcium, none-such special, sapwood antiseptic, sodium fluoride, zinc chloride, zinc sulphate. Another article on the same subject by E. P. Schoch, University of Texas, Austin, is to be found at p. 603 of the same volume.

"The Value of the Higher Phenols in Wood-preserving Oils," by Samuel Cabot, Journ. of Indust. and Engin. Chem., vol. iv., 1912, p. 206, and "Phenomenon of the Apparent Disappearance of the Higher Boiling Phenols in Creosoted Wood and its Explanation" by the same author in the same volume.

"Coal Tar Creosote Distillation and Individual Constituents: Comparative Toxity of Creosote for the Marine Wood Borer (*Xylotrya*)," by F. L. Schackell, American Wood Preservers' Association, Chicago, 1915.

The following three papers were read at a meeting of the Chemists' Club in New York, on November 25th, 1910, and appear in Journ. Soc. Chemical Industry, 1911, p. 190.

"The Actions of Oils and Tars in Preventing Mould Growth," by John Morris Weiss.

"Some Recent Publications on Creosote Oils," by S. R. Church.

"The Characteristics of Creosote and Tar Oils Available for Wood Preservation," by Charles N. Forrest.

"Impregnation of Wood with Brine in Russia," Journ. Soc. Chem. Indus., vol. xxix., p. 1311. It is said that in Russia, particularly in the south-east, brine is very largely used for impregnating railway sleepers and telegraph poles. Though not so efficient a preservative as creosote, brine is considerably cheaper. Special impregnating basins have been constructed in which the sleepers are placed in rows, and allowed to remain in the brine for 3 or 4 months. The brine contains 164 grms. of saline matter (136 grms. of sodium chloride) per litre. The brine does not penetrate far into the wood, the sleepers absorbing from 70 to 100 per cent. of their weight.

Attention ought also to be paid to the publications of the American Wood Preservers' Association, Baltimore.

XVII.—MISCELLANEOUS NOTES.

Maurice L. de Vilmorin.—French horticulture and especially French dendrology has sustained a severe loss in the death of Mr. M. L. de Vilmorin, which occurred at his country residence at Les Barres (Loiret), on April 21 last. In this country also and especially by Kew his loss will be greatly felt. He had for many years been in regular and cordial co-operation with this establishment, and it was to him more than to anyone that Kew was indebted for new Chinese plants in the days prior to the dispatch of collectors direct from this country to China. We may instance the *Davidia* which has lately made so fine a display in the Himalayan House at Kew. This, the first ever seen in England, was given to Kew by Mr. de Vilmorin. Many years ago he established relations with French missionaries in Central and Western China, especially with Delavay, David, Soulie and Farges. From them, stationed in what was at the time a practically unknown country so far as botany was concerned, he received a constant supply of seeds. The plants raised from them he distributed freely. His interests, however, were by no means confined to Chinese plants. At Les Barres, in 1894, he established a collection of shrubs scientifically arranged and probably the most comprehensive in Europe. In 1904 he published the "Fruticetum Vilmorinianum," a valuable list of the species grown at Les Barres, embellished with illustrations and notes.

Mr. de Vilmorin was the senior member of the famous firm of Vilmorin-Andrieux & Co. He fought in the Franco-Prussian war of 1870 and was a man of great culture and charming manners. To the representatives of Kew who visited Les Barres he always offered a warm welcome and kindly hospitality. His death, following so soon after that of his nephew Philippe de Vilmorin and Mr. Allard, of Angers, leaves the ranks of French dendrologists sadly depleted. He was 69 years of age, having been born on February 26, 1849, at Verrières-le-Buisson, the chief home of the de Vilmorin family.

Plantae Thunbergianae.—A few years ago Dr. Daydon Jackson rendered a great service to systematic botanists by preparing an Index to the Linnean Herbarium, which was issued as a supplement to the *Proceedings of the Linnean Society* in October, 1912. We now have the pleasure of welcoming an Index* to another famous herbarium, that of Linnaeus's distinguished pupil and successor in office, Carl Peter Thunberg, which has been compiled by Dr. H. O. Juel, the present Professor of Botany and Director of the Botanic Garden, University of Upsala. Professor Juel has kindly presented a copy of his work to Kew, to

* Plantae Thunbergianae. Ein Verzeichnis der von C. P. Thunberg in Südafrika, Indien und Japan gesammelten und der in seinen Schriften beschriebenen oder erwähnten Pflanzen, sowie von den Exemplaren derselben, die im Herbarium Thunbergianum in Upsala aufbewahrt sind; zusammengestellt von H. O. Juel. Arbeten utgifna med understöd af Vilhelm Exkmans Universitetsfond, Uppsala. Uppsala & Leipzig, 1918. 8vo. 462 pp., with portrait, sketch-map and 1 text illustration.

which he and his predecessors, from the time of Professor Elias M. Fries, have on many occasions afforded invaluable assistance by loaning to it portions of Thunberg's South African collections for use in the preparation of the *Flora Capensis*. The scope of the volume is indicated by the full title which is given on p. 190. The title-page is followed by a portrait of Thunberg, and the preface, which is in German, includes a biographical note, a sketch-map of his travels in South Africa, and a photograph of the memorial to Kaempfer and Thunberg, erected in Nagasaki by Ph. F. von Siebold. The usefulness of the work, which represents so much patience, industry and care, will be gratefully recognised and appreciated by many botanists and particularly by those who are interested in the floras of South Africa and Japan by the knowledge of which Thunberg has furnished us with some classical contributions.

Botanical Magazine.—The following plants are figured in the number for January, February and March:—*Paeonia peregrina*, Mill. (t. 8742), from the Balkan peninsula; *Pteridophyllum racemosum*, Sieb. & Zucc. (t. 8743), a native of the mountains of Central Japan; *Macodes Sanderiana*, Rolfe (t. 8744) from the Malay Archipelago; *Indigofera pendula*, Franch. (t. 8745), from Yunnan; *Agave fourcroydes*, Lem. (t. 8746), a native of Yucatan; *Rhododendron prostratum*, W. W. Smith (t. 8747), a native of the heights of the Likiang Range in Yunnan; *Echeveria setosa*, Rose & Purpus (t. 8748), from Southern Mexico; *Petunia integrifolia*, Hort. ex Harrison (*P. violacea*, Lindl.) (t. 8749) a native of Paraguay, Uraguay, S. Brazil and the Argentine; *Rhododendron brachyanthum*, Franch. (t. 8750), native of the Tali Range, Yunnan and *Asparagus falcatus*, Linn. (t. 8751) from Ceylon and also a native of Tropical and extra-Tropical South Africa.

In the number for April, May and June the following plants are figured:—*Primula anisodora*, Balf. f. et Forr. (t. 8752) from Yunnan; *Odontochilus lanceolatus*, Benth. (t. 8753) from Sikkim and Khasia; *Zanthoxylum planispinum*, Sieb. et Zucc. (t. 8754) from Japan; *Erlangea aggregata*, Hutchinson (t. 8755) a native of Angola; *Monadenium erubescens*, N. E. Brown (t. 8756) a native of Somaliland and Abyssinia; *Malus Sargentii*, Rehd. (t. 8757) from Japan; *Angraecum gracilipes*, Rolfe (t. 8758) a native of Madagascar; *Rhodendron siderophyllum*, Franch. (t. 8759) from Yunnan; *Howea Belmoreana*, Becc. (t. 8760) indigenous to Lord Howe's Island; *Bulbophyllum sociale*, Rolfe (t. 8761) a native of Sumatra; *Primula sylvicola*, Hort. ex Hutchinson (t. 8762) from Yunnan; and *Melicytus ramiflorus*, Forst. (t. 8763) from New Zealand and Polynesia.

A Rain Tree.—Dr. G. V. Perez, of Teneriffe, has sent us the following abridged translation of an article contributed by him to the Spanish paper "Real Sociedad Española de los Amigos del Árbol," No. 77, January, 1918, on how trees in a forest where mists usually form, precipitate water to a very remarkable extent.

The famous rain-tree in the Island of Ferro, Canaries, Dr. Perez writes, grew "on a headland where the mountain mists from the Trade winds collected, and by means of water tanks under it, the poor inhabitants of that island, where there are no springs, actually gathered enough water for drinking purposes. The tree was undoubtedly *Oreodaphne foetens*, Nees, because the old historians said it was like a laurel, but the fruit resembled the acorn of an oak."

The following is the abridged translation of the article:—

"How the mist collected over Table Mountain, south of Cape Town, is compared by travellers to a tablecloth; these clouds form more in the summer or rainless months when the S.E. winds blow harder.

"Dr. Marloth's experiments by means of two rain gauges, one representing the forest, are quoted, showing that from Dec. 1902 to Feb. 1903 nearly 80 in. (2 metres) of water was collected in the rain gauge representing the forest and very little in the other.

"Braine, in his book *Influence of Forests on Natural Water Supply*, obtained the particulars given above from the *Transactions of the South Africa Philosophical Society*, vols. 14 and 16.

"In the Canary Islands the Trade or N.E. winds bring about the formation of a similar belt of clouds between say 2000 and 5000 ft. altitude, where the evergreen forest of the Atlantic Islands grows best and amongst them a laurel called Til, which was undoubtedly the famous Garoe or Holy Tree of the Island of Ferro, which actually supplied that fountainless island with drinking water for the inhabitants until a storm blew it down.

"Anybody who has gone through a forest in the Canaries covered with mist can bear witness as to how much water is condensed by the foliage where trees grow.

"What creditable historians relate about the Holy Tree of Ferro is not a miracle but a scientific fact which has been proved at a similar altitude (Table Mountain) near Cape Town under similar circumstances and this fact should never be forgotten by those who sustain a campaign in favour of covering arid mountains by forests and thus utilizing the mountain mists in suitable localities."

VI.

ACTINOTUS RUSBY.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 6] [1918

XVIII.—ON THE LIFE HISTORY OF THE ROSE BLOTCH FUNGUS.

STUDIES FROM THE PATHOLOGICAL LABORATORY: VIII.

N. L. ALCOCK.

(With Plate.)

The fungus *Actinonema rosae* is familiar to all rose growers in this country who know only too well the black blotches it produces on the leaves of many kinds of roses. All through the summer and autumn months it produces conidia in great abundance, infecting the new foliage of growing shoots as fast as it develops. The fungus not only greatly disfigures the rose foliage, but it actually weakens the shoots through the destruction of the leaf tissues and the premature defoliation which bad attacks bring about.

In devising methods of control there has always been a difficulty, since mycologists until recently have been without information as to its method of hibernation and the origin of the new attack each season. Recently this problem has been solved for the United States through Dr. F. A. Wolf, of Cornell University, having found an ascigerous stage on the dead leaves (Bot. Gaz. 1912, Sept. p. 218). The perithecia mature in April, discharging ascospores which infect the young foliage as it unfolds. To this form Dr. Wolf has given the generic name *Diplocarpon*. The new genus belongs to the family *Microthyriaceae* (*Perisporiales*). This family is characterised by having perithecia which are shield-shaped, flat, with a round pore at the apex and a membrane formed only on the upper side. Dr. Wolf examined other genera of this family, but came to the conclusion that the fungus was sufficiently distinct to be regarded as a distinct genus. His observations on the conidial stage show that the genus *Marsonia* (to which Professor Trail referred the fungus in 1889, *see* Scottish Naturalist, vol. iv, N.S. 1889-90, p. 73, and with which it agreed in some respects) was not altogether suitable for its reception.

The development of an ascigerous stage does not seem to take place in Great Britain, for though it has been repeatedly searched for, it has not yet been found. In 1916 leaves of roses affected with Black Blotch and collected at Lyndhurst in September were

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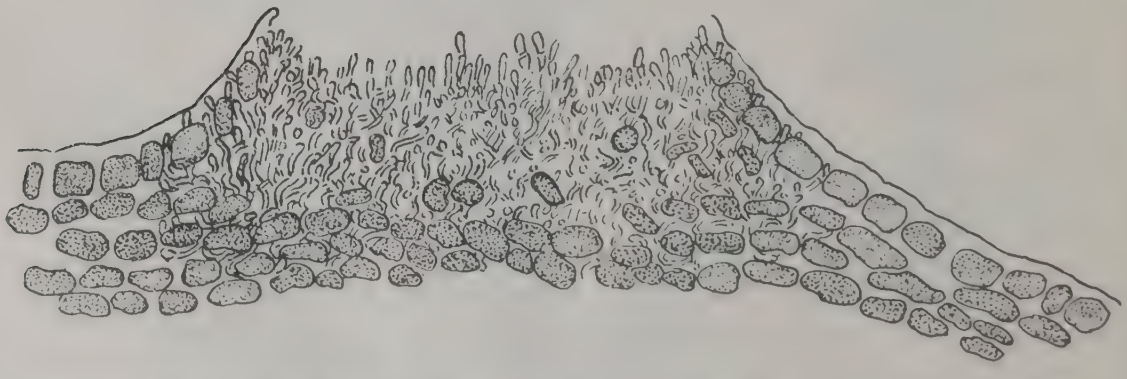
brought to Kew and kept out of doors under fairly natural conditions. When examined in spring no ascigerous stage had appeared nor has any British botanist, as far as we know, succeeded in finding perithecia.

When pruning roses this spring patches of discoloured tissue were noticed on the young wood of the previous season, apparently caused by some fungus trouble. The variety on which they occurred was Juliet. On examination these were found to contain abundant mycelium and compact masses of fungus-tissue bearing spores of *Actinonema rosae*.

Description of infected wood.—The infected areas present a blackened, blistered appearance dotted with pustules (Plate VI), the fungus forming a stromatic cushion or pad below the cuticle (Figs. I & II). The mycelium itself is colourless, and was, as far as the material showed, confined to the cortex, where it developed considerably and killed the tissues. The spores and conidiophores of the sorus or acervulus (Fig I) stand out clearly amid the surrounding cells, the contents of which become dark, and in later stages completely disorganised. If one of the stromatic cushions be sectioned it will be found to be composed of a thick mass of closely interwoven hyphae which develops immediately beneath the cuticle and forces it upwards until it is finally ruptured (Fig. II). In spring the mycelium gives rise to numbers of short conidiophores at right angles to the cushion. The

Text fig. 1.—Section through the cortex of a one-year old shoot showing young acervulus with conidiophores and spores. × 200.



Text fig. 2.—Section through dormant cushion on a one-year old rose shoot showing compact mycelial tissue commencing to give rise to spores in spring. × 200.

conidiophores bear spores which are precisely similar to those formed on the leaves, namely, hyaline, 2-celled, and oval to elliptic in shape. In size they vary a good deal, being 17-26 μ long by 5-6 μ. They are somewhat constricted at the septum, and occasionally the two cells separate and function as two distinct spores. The spore-bearing layers were found not only in the outer cortical tissues, but also in cavities situated deep in the cortex, and formed apparently by the development of mycelium. The fungus produces spores in profusion in these spaces, the conidiophores in many cases lining both sides of the spaces, and thick mycelial cushions may even occasionally be developed. When the spores mature, they are apparently liberated into the central cavity.

In the case of rusts, internal sori are not uncommon, and have been found in *Uromyces caryophyllinus*, *U. caladii*, *Puccinia graminis*, *P. glumarum*, and others. *Cronartium ribicola* occasionally forms teleutospores deep in the tissue of the petiole, and the teleutospores have been found to be living after a considerable time, even in comparatively dry conditions (*see* Colley, Journ. Agric. Research, vol. viii, 1917, pp. 329-332; Adams, Mycologia, vol. viii, 1916, pp. 181, 182).

A feature of interest in connection with the above discovery is the fact that the difference in the methods of hibernation in England and the United States is exactly comparable to that which occurs in these two countries in the case of the Apple Scab fungus (*Venturia inaequalis*).

In Germany and America the scab fungus has been found to produce perithecia in the dead tissues of the leaves and to liberate ascospores in spring (Aderhold, Ber. Deut. Bot. Gesell., vol. xii, pp. 338-342; Wallace, Cornell University Bulletin No. 335. 1913). In England the ascigerous stage, though often sought for, has never been found. In 1906, however, Mr. Salmon discovered that the *Fusicladium* stage formed mycelial cushions on the young wood which remained dormant till spring, when they produced and liberated spores (Gard. Chron., July 14, 1906, p. 21; Journ. S.E. Agric. Coll., Wye, 1907, p. 291). The cushions produced by *Actinonema rosae* are precisely comparable to those of *Fusicladium*, and function in the same manner. It should however, be mentioned that since Mr. Salmon's paper appeared, specimens of apple and pear twigs bearing the same cushions have been found in some of the Atlantic States (Maine Agric. Expt. St. Bulletins No. 223, 1914; No. 252, 1916; Phytopathology, vol. iii, p. 265, 1913).

Varieties Attacked.—The season was well advanced (April) when the infection on the young wood of Juliet was first observed, consequently roses in most gardens had already been pruned and it was not possible to obtain much further material, or a full list of varieties which are infected in this manner. The fungus is scarce in the Royal Botanic Gardens, Kew, and soon apparently dies out if introduced in the neighbourhood. A visit was therefore paid to the Royal Horticultural Society's Gardens at Wisley where, thanks to the kind help afforded by the Superintendent,

Mr. S. T. Wright, the following varieties were found to be attacked on the wood, Madame Ravary, La Tosca, Mrs. David Jardine, Gruss an Teplitz, which are all hybrid teas, and Juliet. The last named is an Austrian Briar—tea hybrid, and it apparently inherits from the Austrian Briar a great tendency to black blotch.

Control Methods.—The discovery of the winter stage on the wood necessitates a modification in the methods of control. Up to the present, owing to lack of information as to its behaviour in Britain and from the fact that ascospores are produced in America on the old leaves in spring, stress has always been laid on the collecting and burning of diseased leaves. As far as is known, however, this is not of avail for this country,* and the attention of the cultivator should be turned to the use of the pruning knife. The plate shows the close proximity of the delicate young foliage to the spore pustules, and demonstrates the ease with which it would be infected. Pruning, however, will need to be carried out with care as the requirements of the different groups of roses will have to be studied in addition to the necessity of removing all affected wood. As far as has been observed the old pustules on the two-year old wood become effete, and do not bear spores. Attention need therefore only be concentrated on the wood of the previous season. It should, however, be remembered that not all brown specks and spots on rose wood are due to *Actinonema*, and in case of doubt specimens should be examined microscopically.

With regard to spraying, liver of sulphur has been recommended in this country, but in many cases without much success. This was probably partly due to its being applied late in the season, when the fungus had obtained a firm hold on the tree. Experimental work on spraying has been carried out in America, and a series of trials conducted by Mr. L. M. Massey at Ithaca (Phytopathology, vol. viii, no. 1, Jan. 1918, p. 20) showed that dusting repeatedly with a powder composed of 90 parts finely ground sulphur and 10 parts powdered arsenate of lead was very effective in controlling blotch. In these trials the trees were dusted eight times during the season. The next most effective agents were found to be Bordeaux mixture 5-5-50, and lime sulphur, but both of these much disfigured the trees.

In gardens which suffer severely from black blotch it would be advisable to spray or dust the trees with fungicide, even though they had been carefully pruned, since some pustules are almost certain to escape attention, and spores might moreover be carried by the wind from neighbouring gardens. It is most important to commence spraying early so as to prevent the fungus obtaining an entry into the leaves, as when once this has been effected the mycelium continues to grow between the tissues and the blotches inevitably follow. To keep the bushes absolutely clean it will,

* Since the above was written infected leaves which had remained green throughout the winter have been observed on various kinds of roses bearing abundant conidia. The collecting and burning of such leaves remains, therefore, a valuable control measure.

judging from the American experiments, probably be necessary to spray at intervals of about a month.

EXPLANATION OF PLATE VI.

Actinonema rosae. Portion of one-year old rose shoot "Juliet" in April, showing the winter infection of the stem.

XIX.—THE OIL PALM IN THE CAMEROONS.

The "Ergänzungsheft" No. 13 of "Mitteilungen aus den Deutschen Schutzgebieten," Berlin, 1917, is occupied by an exhaustive account of the grass highlands of the North-west Cameroons, by Kurt Hassert, illustrated by two maps and some plates of photographs. This, which is only the first part and consists of 144 pages, deals with the physical geography of the region and its plant formation. Under the heading useful wild plants, accounts are given of rubber, kola, cotton and oil palm.

The section dealing with the Oil Palm in the Cameroons (pp. 115-120), includes some information not previously published in this *Bulletin*. One of the maps shows the distribution of the different types of flora and in addition the localities where oil palm and kola are abundant are clearly indicated.

The oil-palm (*Elaeis guineensis*) occurs in the Cameroons principally in the lowlands occupied by primeval forest. Districts economically important for its produce near the coast are Duala, Jabassi, Edea and Rio del Rey, while further inland the territories of Bakundu, Kabo and Bangwa produce this palm in remarkable abundance. Extensive areas of grassy highlands are also rich in oil-palms, and the trees form a marked feature of declivities where a transition from grassland to forest takes place, the palms occurring in such quantity on the edge of the slope as to form woodlands.

Forest of nearly pure growth of oil-palm occupies large stretches of ground in various localities, e.g., on declivities of the Bambuto Range, and in valleys of the Mbo Mountains.

There is a striking paucity of oil-palms in the Southern highlands of Dschang, and this feature becomes more and more pronounced as one follows the grassland eastward.

The mode of occurrence of the palm varies greatly. Thus it grows wild or half-wild, and scattered as numerous isolated specimens in primary or secondary forest or on farmlands. It is also found forming groups in valleys and on slopes of mountains, or, as mentioned above, it may constitute almost pure palm-forest. Another mode of occurrence is as a dense zone around a village, being kept in this case in a state of semi-cultivation. The Banyang villages are encircled by oil-palms in this way.

Besides a high temperature, the special requirement of the tree is sufficient moisture, only scanty produce being yielded when the rainfall is less than 100 or 150 cm. The tree is fairly sensitive to drought, when the latter is somewhat prolonged; but otherwise it is relatively adaptable. Thus it not only grows in abundance in the forest-lowlands, which are warm and damp, being subject to much rain, but it also occurs on the grasslands

to a considerable elevation, still giving good crops in these situations. The upper limit of its growth may be taken as usually between 1200 and 1300 metres. On the Bana highlands, however, it reaches 1450 metres, and bears plenty of fruit, while in the Cameroon Range it ascends to 1000 metres, but the limit of its productiveness is attained there at about 700 metres.

The occurrence of the oil-palm is in many cases an indication of previous human occupation. It is one of the characteristic plants of the secondary forest, which has mostly grown up on the land of deserted farms or settlements.

The presence of oil-palms in undoubted primary forest is regarded as being due to the transport of the nuts by monkeys, birds, etc., while a good deal of dispersal on steep slopes is attributed to the action of rain-water.

The typical oil-palm which is so widely distributed in the Cameroons is called Dilombe or Dipobe, and its fruit contains a hard shell. A different variety (*E. guineensis* var. *microsperma*), which is known as Lisombe, differs in having a fruit with a thin shell, and is of only isolated occurrence; it never is gregarious and in some districts it does not occur at all.

Germany consumes more than half the world's commercial supply of the produce of oil-palms. Besides the imports from the Cameroons and Togoland, Germany obtains palm-oil and kernels to the value of about 100 million marks annually from British Nigeria, the amount of the same products exported from the Cameroons in 1912 being valued at 6 million marks.

Oil-fruits may well become the most important article of export from the Cameroons, since the oil-palm is much more abundant than was supposed some time ago. The difficulties and expense of transport at present prevent the quantities of fruit occurring in regions far from the coast from being utilised. Products of the oil-palm for export consequently come chiefly from river territories near the coast, e.g., Lower Sanaga, Wuri, Mungo, Rio del Rey and Cross River, that dispatched by the Cross River being taken for the most part over the frontier to the British coast-factories. It is to be expected that a future extension of the Northern Railway would make it possible to considerably increase the export of oil from the Cameroons.

The cultivation of the oil-palm in plantations is being continually extended in regions near the coast. It has been estimated that about 200 plants can be planted on 1 hectare of well cleaned soil (i.e., 80 to the acre), but the number of palms to the hectare is supposed to average about 60 in the plantations of the Cameroon Mountains, and is stated to be 45 in the region of the Upper Cross River. An idea can be formed of the yield which might be expected from 1 hectare of plantation by assuming one tree to produce 30 to 40 kilos of fruit, this yield giving about 3 kilos of oil and the same weight of kernels.

The oil-palm is certainly one of the most important productions of the Cameroons, and will perhaps become more important than cotton, cocoa and rubber; indeed, palm-oil and palm-kernels have been described as the backbone of West African commerce.

XX.—A DISEASE OF THE YAM.

(*Bagnisiopsis Dioscoreae.*)

E. M. Wakefield.

In January of this year Mr. C. O. Farquharson, Mycologist, Agricultural Department, Southern Provinces, Nigeria, subsubmitted for identification stems of a yam attacked by a fungus. The yam affected is *Dioscorea prehensilis*, Benth.; the fungus is obviously a parasite, and the attack, though localised, is severe.

Mr. Farquharson supplies the following notes:—"The specimens were collected early in November, 1917, in the Okigwi district of the Southern Provinces of Nigeria. So far I have only met the disease in this district.

"Only the round-stemmed yams are attacked, never the alate-stemmed 'water-yam' types. So far as I was able to judge in the very limited time which I had at my disposal to study the disease, the vines are rarely completely involved. Generally a branch is attacked and its secondaries, the effect produced being very striking and characteristic. There is a reduction in node length and leaf size, but no adventitious growths, although the swelling of the attacked haulms, together with the tiny rather chlorotic leaves, produces the appearance of a witch-broom. The leaves are in no way distorted, nor swollen, nor does the fungus ever spore on the leaves. The effect of the little green leaves attached to the swollen vine branch, which may be quite black with the stromata of the fungus, is very striking and unusual. I did not see early stages of attack but the fungus is undoubtedly parasitic.

"The yams vines are attacked on poor or swampy situations, but as already indicated the whole vine is rarely involved. The simplest remedy would be to cut off the affected parts as soon as noticed. Though occurring more than sporadically, the trouble could not be described as epidemic. I have never seen it in any other district though the varieties did not appear to be dissimilar to those commonly grown in other districts. The district where the disease was found is rather high lying, and it had the nearest approach to an alpine type of flora that I have yet met. I must add that most of my travelling has been done in the more low-lying districts."

No previous record of such a disease of *Dioscorea* can be traced; the yams as a rule appear to be remarkably free from serious insect and fungus pests. The fungus belongs to the order *Dothideales*, family *Dothideaceae*, and is described below. It attacks the lateral shoots which arise in the axils of normal leaves and causes marked hypertrophy (fig. a). The internodes are shortened and the leaves dwarfed, and where the elongated black stromata break through the tissues of the stem the latter appears much swollen. The stromata arise from the central cylinder of the stem and burst through the cortex and epidermis. Frequently numerous elongated stromata occur parallel to one another, so that the cortex is almost entirely replaced by fungus tissue. In such cases strips only of the torn cortex and epidermis remain between the

EMW. del

stromata (see fig. b), or in extreme cases the stromata may even coalesce entirely.

Under the hitherto generally accepted nomenclature of Saccardo's Sylloge the fungus would have been placed in the genus *Bagnisiella*, Speg., which was distinguished from *Phyllachora* by the pulvinate, erumpent stroma. Theissen and Sydow* have shown, however, that the type of the genus *Bagnisiella, B. australis*, Speg., differs from true *Dothideales* in having, in place of true loculi, a "kontinuierliche Fruchtschicht," thus suggesting relationship with the Discomycetes. They therefore confine *Bagnisiella* to this species, excluding it from the *Dothideales*, and constitute two new genera, *Bagnisiopsis* (with paraphyses) and *Amerodothis* (without paraphyses), for the true *Dothideales* with hyaline continuous spores and erumpent stromata which were previously referred to *Bagnisiella*. The fungus described below possesses paraphyses, and appears to be a new species of *Bagnisiopsis*.

Bagnisiopsis Dioscoreae, *Wakefield.*

Stromata erumpentia, sublineare-elongata, pulvinata, superficie ob loculos prominulos rugosa, atra, 1 mm. diametro, contextu pseudoparenchymatico. *Loculi* numerosi, globosi, ad 500 μ diametro. *Asci* cylindrici, apice rotundati, brevissime stipitati, octospori, 120-135 × 12-15 μ. *Paraphyses* filiformes, 2·5-3 μ diametro, ascos aequantes. *Sporae* monostichae, oblongae, utrinque obtusae, hyalinae, interdum polari-guttulatae, 17-18 × 7-8·5 μ.

Nigeria. Southern Provinces: Okigwi district; on stems and petioles of *Dioscorea prehensilis*, Benth., *C. O. Farquharson*, Nov. 1917.

The same fungus has also been found on another specimen of *D. prehensilis*, collected by Mr. and Mrs. P. A. Talbot at Oban, South Nigeria, in 1911 (*Talbot*, 726 *in Herb. Kew*).

Explanation of Figures.

a. Portion of *Dioscorea* plant showing hypertrophied lateral shoot with stromata of *Bagnisiopsis Dioscoreae* (nat. size).

b. Transverse section of stem from hypertrophied shoot, showing three stromata of *Bagnisiopsis* arising from the central vascular cylinder; the dotted regions between the stromata represent cortex (× about 12, diagrammatic).

c. Ascus of *B. Dioscoreae* (× 550).

d. Spores (× 550).

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* Theissen, F., and Sydow, H. Die Dothideales, in Ann. Myc. xiii. 1915, pp. 651–652.

XXI.—DIAGNOSES AFRICANAE: LXXI.

1621. **Raphidiocystis ugandensis,** *Rolfe* [Cucurbitaceae]; a *R. Welwitschii,* Hook. f., foliis repando-lobatis et fructibus ovoideis griseo-villosis (nec rufo-villosis) differt.

Caules subgraciles, angulati, pubescentes, longe scandentes. *Folia* late cordato-ovata, subobtusa, 7-nervia, 8-12 cm. longa, 4-9 cm. lata, supra sparse strigosa et crebre lenticellata, venis copiose strigosis, subtus pubescentia, margine in sinu dente acuto instructa; petioli pubescentes, 1·5-4 cm. longi. *Flores* masculi haud visi; flores feminei axillares, solitarii, pedunculati; pedunculi pubescentes, circiter 1·5 cm. longi; ovarium ovoideum, copiose griseo-villosum, circiter 1·5 cm. longum. *Calycis* segmenta triangulari-subulata, 2 mm. longa. *Corolla* tubulosa, prominenter striato-venosa, 1 cm. longa, tubo lato 0·6-0·7 cm. longo, lobis rotundo-ovatis 4-5 mm. longis. *Stigmata* lobata, 1 cm. longa. *Fructus* immaturus circiter 3 cm. longus.

Tropical Africa. Uganda: Mabiri Forest, savannah near Naminyama, 1220 m., October, 1916, *R. Dummer* 2991. Flowers reddish.

1622. **Salvadora angustifolia,** *Turrill* [Salvadoraceae]; affinis *S. oleoidi,* Dcne, sed foliis 3-5-nervatis, squamulis interstaminalibus majoribus distinguenda.

Frutex ramosus, caulibus cylindricis glabris, interdum glaucescentibus. *Folia* linearia, saepe plus minusve falcata, apice acuta, basi in petiolum gradatim angustata, usque ad 10 cm. longa, saepissime 6-7 mm. sed interdum usque ad 1·3 cm. lata, margine integra. *Inflorescentia* axillaris vel terminalis, multiflora, ramosa, ramis glabris, floribus fere sessilibus; bracteae minutae, vix 1 mm. longae, triangulares, apice acutae. *Calyx* 4-lobus, 1-2 mm. longus, lobis obovatis apice rotundatis. *Corolla* alba, petalis 4 a basi connatis elliptico-obovatis circiter 2-3 mm. longis et 1·25 mm. latis apice rotundatis. *Stamina* 4, filamentis 1·25 mm. longis. antheris 0·75 mm. longis. *Squamellae* 4, staminibus alternae, triangulares, apice plus minusve truncatae, 0·25 mm. longae. *Ovarium* late pyriforme, 1 mm. altum, fere 1 mm. diametro, uniovulatum; stigma sessile. *Drupa* immatura ovoideo-pyriformis.

Mascarene Islands. Madagascar: Tulear, *P. A. Methuen*; St. Augustin's Bay, *Bouton*; *Admiral Bowles*; without precise locality, *Grevé*. Aldabra Group, *Dupont*, 15; Cosmoledo, *Fox*, 289.

According to Fox the local name of this plant in Cosmoledo is Tambalocoque.

1623. **Apterantha,** *C. H. Wright* [Amarantaceae]; gen. nov. ex affinitate *Pleuropteranthae,* Franch., a qua perianthii segmentis aequalibus 1-nerviis differt; a *Digera,* Forsk., utriculo circumscissili distinguitur.

Flores hermaphroditi. *Perianthii* segmenta aequalia, scariosa, 1-nervia, imbricata. *Stamina* 5, perianthio breviora; filamenta

basi cupulatim connata; antherae oblongae, 2-loculares. *Staminodia* 0. *Ovarium* sessile, subglobosum; stylus fere ad basin 2-partitus; stigmata linearia. *Utriculus* membranaceus, prope basin circumscissilis. *Semen* erectum, a latere compressum; testa crustacea; embryo annularis; endospermum copiosum, farinosum.—*Planta* herbacea vel sublignosa, erecta. *Folia* alterna, simplicia. *Cymae* breves in spicas terminales elongatas disposita.

Species unica.

A. oligomeroides, *C. H. Wright. Planta* ramosa, erecta, herbacea vel sublignosa, glabra, 24 cm. alta. *Folia* alterna, indivisa, anguste lanceolata vel spathulata, acuta vel acuminata, basi angustata, ad 4 cm. longa et 5 mm. lata. *Spicae* plures, terminales, multiflorae, 4-8 cm. longae, simplices vel pauciramosae; bracteolae ovatae, concavae, scariosae, perianthio breviores. *Perianthii* segmenta 2, aequalia, scariosa, oblonga, 1 mm. longa, acuta, 1-nervia. *Stamina* 0·75 mm. longa; filamenta subulata, basi in cupulam brevem connata; antherae oblongae, filamentis breviores, 2-loculares. *Staminodia* nulla. *Ovarium* sessile, subglobosum; stylus fere ad basin 2-partitus, ramis latere interiore stigmaticis. *Utriculus* vix 1 mm. longus, membranaceus, hyalinus, a latere compressus. *Semen* erectum, lenticulare, utriculo conforme; testa nigra.

Mascarene Islands. Aldabra, *Dupont*, 56; *Thomasset*, 237.

1624. **Loranthus aldabrensis,** *Turrill* [Loranthaceae]; affinis *L. Baroni*, Baker et *L. clavato*, Desr., ab hoc floribus saepissime majoribus, calyce fere truncato lobis latioribus et minus prominentibus, ab illo limbo corollae in alabastro ob margines prominulos quasi 5-carinato vel fere 5-alato, bracteis cupularibus haud gibbosis distinguitur.

Planta glabra, ramosa, ramis teretibus griseo-brunneis densiuscule lenticellatis. *Folia* opposita, petiolata, oblongo-elliptica, saepissime 5-8 cm. longa et 2-3·5 cm. lata, coriacea, penninervia, nervis pagina superiore saepe prominentibus pagina inferiore inconspicuis lateralibus obliquis; petiolus 0·5-0·75 mm. longus. *Fasciculi* axillares, 1-3-flori; pedicelli 4 mm. longi; bractea asymmetrice cupularis, oblique truncata vel interdum altero latere in lobum acutum producta, leviter ciliata. *Flores* pentameri. *Torus* cum calyce oblongus vel oblongo-obconicus, 5 mm. longus, 2· mm. diametro. *Calyx* cupularis, fere truncatus, 1 mm. longus, lobis saepissime inconspicuis et irregularibus usque ad 2 mm. latis margine leviter ciliatis. *Corolla* matura 4 cm. longa, limbo in alabastro oblongo-ellipsoideo ob margines prominulos quasi 5-carinato vel fere 5-alato; tubus gracilis, subpentagonus, basi haud inflatus, unilateraliter fissus (?); lobi 7-8 mm. longi, 1 mm. lati, lineari-lanceolati, subacuti. *Filamenta* basi corollae loborum inserta, erecta, 1·5 mm. longa; antherae lineares, 4 mm. longae, haud transverse septatae. *Discus* inconspicuus. *Stylus* filiformis, stigmate capitato 0·75 mm. longo.

Mascarene Islands. Aldabra, *H. P. Thomasset*, 229; *J. C. F. Fryer*, 8; *Dupont*, 10. *W. Fox*, 241, with young fruit only, and

Dupont, 107, without flowers or fruit, probably belong to this species.

1625. **Phyllanthus Cheloniphorbe,** *Hutchinson* [Euphorbiaceae-Phyllantheae]; affinis *P. anomalo*, Muell.-Arg., sed foliis apice rotundatis pedicellis ♂ multo brevioribus differt.

Arbor parva, ligno molli (*Dupont*); ramuli tortuosi, cinerei vel purpurascentes, hornotini glaucescentes, glabri. *Folia* obovata vel obovato-elliptica, apice rotundata, basin versus sensim attenuata, 2·5-9 cm. longa, 1·5-4·5 cm. lata, primum tenuiter demum firme chartacea, integra, sicco cinereo- vel flavo-viridia, distincte nervosa sed obscure reticulata, glabra; costa plerumque straminea, supra sulcata, infra prominens; nervi laterales utrinsecus 8-9, a costa sub angulo lato abeuntes, utrinque prominuli; petioli 4-8 mm. longi, rugulosi, glabri. *Flores* dioici, axillares, ♂ dense fasciculati, breviter pedicellati, ♀ paucifasciculati vel rare subsolitarii. *Flores* ♂: pedicelli usque ad 4 mm. longi, glabri; bracteae exteriores coriaceae, suborbiculares, ad 3 mm. diametro, interiores oblongae, apice rotundatae, subhylinae; sepala 4, oblongo-elliptica, 2·5 mm. longa, 1·5 mm. lata, glabra; disci glandulae transverse oblongo-ellipsoideae, discretae sed fere contiguae; filamenta libera, 1·5 mm. longa; antherae oblongae, 1 mm. longae, longitudinaliter dehiscentes. *Flores* ♀: pedicelli usque ad (in fructu) 1·5 cm. longi, apicem versus leviter incrassati, angulares; sepala 4, inaequalia, late ovata vel oblongo-ovata, apice rotundata, dorso carinata, 2-2·5 mm. longa, marginem versus hyalino-membranacea; discus patelliformis, obscure crenulatus; ovarium ampulliforme, glabrum, stigmatibus subsessilibus 4 reflexis subulato-lanceolatis carnosis cronatum. *Fructus* dicoccus, ambitu subglobosus, 6-7 mm. diametro, glaber. *Semina* triquetra, laevia, dorso convexa, lateralibus fere plana, brunnae ,4 mm. longa, 3 mm. lata.

Mascarene Islands. Aldabra, *W. L. Abbott*; *H. P. Thomasset*; *Dupont* 66, 112, 116; *Fryer* 17, 35, 87.

According to Dupont this is a small tree with a soft wood, the leaves of which are eaten by tortoises.

1626. **Cluytiandra peltata,** *Hutchinson* [Euphorbiaceae-Phyllantheae]; inter species adhuc descriptas foliis peltatis distinctissima.

Frutex ramosus; ramuli laxe foliati; cinereo-virides, compresso-angulati, glabri. *Folia* longe petiolata, peltata, ovata vel ovato-lanceolata, subacuta, basi rotundata, 2-4 cm. longa, 1-2 cm. lata, tenuiter chartacea vel fere membranacea, glabra; nervi laterales utrinsecus 7-8, a costa sub angulo lato abeuntes, utrinque prominuli; petiolus supra basin laminae 1·5 mm. insertus, 0·5-2 cm. longus, gracilis, glaber; stipulae lanceolatae, acutae, 1·75-2 mm. longae, glabrae. *Flores* monoici, axillares, solitarii, ♂ breviter, ♀ demum longissime pedicellati. *Flores* ♂: pedicelli filiformes, 4 mm. longi; sepala 5, oblongo-ovata, 1 mm. longa, viridia, glabra; discus patelliformis, crenulatus; stamina 5, filamentis fere liberis; ovarii rudimentum minutum, trilobulatum.

Flores ♀ : pedicelli-demum 3·5 cm. longi, filiformes, apicem versus leviter incrassati; sepala late ovata, sub fructu persistentia; capsula oblonga, 7 mm. longa, lobata, leviter verrucosa; semina matura non visa.

Madagascar. Central districts, *Rev. R. Baron* 4198, 4231.

This is a very remarkable species of *Cluytiandra*, a genus not hitherto recorded outside the African continent. The peltate leaves distinguish it at once from all other African *Phyllantheae*.

1627. **Cluytiandra Baronii,** *Hutchinson* [Euphorbiaceae-Phyllantheae]; species foliis magnis usque ad 9 cm. longis facile distinguitur.

Ramuli glabri, annotini angulati, cinerei vel purpurascentes. *Folia* elliptica vel oblongo-elliptica, basi rotundata, apice acute mucronata, 4·5-9 cm. longa, 2·5-5 cm. lata, tenuiter chartacea, supra viridia, infra glauca, margine (praecipue basin versus) recurvata; costa supra leviter impressa, infra prominens, straminea; nervi laterales utrinsecus 8—10, supra leviter impressi, infra prominuli, a costa sub angulo fere 90° abeuntes, prope marginem arcuati et conjuncti, venis laxis prominulis; petioli 0·5-1·2 cm. longi, glabri; stipulae caducae, squamiformes, nitidae. *Flores* ut videtur dioici, ♂ inracemos brevissimos dense bracteatos axillares dispositi; bracteae stipuliformes, imbricatae; pedicelli filiformes, usque ad 1 cm. longi; sepala 5, suborbicularia, submembranacea, 1·75 mm. longa et lata, glabra; discus patelliformis, tenuis, integer; ovarii rudimentum crassum, subintegrum. *Flores* ♀ haud visi.

Madagascar. Chiefly North-West Madagascar, *Rev. R. Baron* 5606, 5630.

1628. **Acalypha claoxyloides,** *Hutchinson* [Euphorbiaceae-Crotoneae]; inter species africanas foliis supra dense pustulatis infra glandulosis mox glabris, inflorescentiis lanato-tomentosis distincta.

Frutex ramulis vetustioribus cinerascentibus lenticellis corticatis notatis, junioribus minute pubescentibus mox glabratis. *Folia* ovato-elliptica, basi rotundata, obtuse acuminata, 7-12 cm. longa, 3-6 cm. lata, subdupliciter crenata, basin versus subintegra, tenuiter chartacea, supra pustulata, primum infra glandulosa, mox glabra, laxe reticulata, sicco flavo-viridia; nervi laterales utrinsecus 5-6, a costa sub angulo 45°-60° abeuntes; petioli brunnei, 1-3 cm. longi, parce puberuli, mox glabrescentes. *Inflorescentia* bisexualis, floribus basalibus 2-3 ♀, vel interdum omnibus ♂, usque ad 2·5 cm. longis; bractae ♂ ovatae, subacutae, lanato-pubescentes, 1·25 mm. longae, ♀ biflorae, late reniformes, circiter 8 mm. latae, minute denticulatae, extra glandulosae et puberulae. *Calyx* ♀ trilobus, extra pubescens, lobis triangularibus subacutis. *Ovarium* dense glandulosum et parce pubescens; styli graciles, 2·5 mm. longi laciniati. *Fructus* haud visus. *Claoxylon* sp., Baker in Kew Bull. 1894, 150.

Mascarene Islands. Aldabra, Oct.-Dec., 1892, *W. L. Abbott*; *Fryer* 18. Astove, Cosmoledo and Aldabra, one of the commonest shrubs, Apr., 1907, *H. P. Thomasset*, 243.

1629. **Acalypha Fryeri,** *Hutchinson* [Euphorbiaceae-Crotoneae]; affinis *A. fruticosae*, Forsk., sed foliis infra minus glandulosis haud pubescentibus et bracteis ♀ conspicuis differt.

Frutex ramulis annotinis strictis cinereis defoliatis, hornotinis brunneis parce pubescentibus et foliatis. *Folia* ovata vel ovato-lanceolata, basi rotundata vel subcuneata, apice obtusa, 2-4·5 cm. longa, 1·5-3 cm. lata, tenuiter chartacea, crenata, supra glabra, infra primum peltato-glandulosa, mox fere glabra, laxe reticulata; nervi laterales utrinsecus circiter 5, a costa sub angulo 45° abeuntes; petioli graciles, parce puberuli, usque ad 1 cm. longi. *Inflorescentia* bisexualis, graciliter pedunculata, usque ad 5·5 cm. longa, inferne floribus ♀ circiter 2 leviter superpositis, superne floribus ♂ breviter spicatis; bracteae ♂ parvae, ovatae, pubescentes, ♀ reniformes, in fructu 1 cm. longae et 1·4 cm. latae, crenato-serratae, recticulatae, extra parce glandulosae biflorae. *Calyx* ♀ cupularis, 3-dentatus, 1·5 mm. longus, dentibus triangulari-subulatis acutis parce pubescentibus. *Ovarium* depresso-globosum, dense glandulosum et parce puberulum; styli graciles, 3 mm. longi, lobis lateralibus filiformibus 2 mm. longis. *Capsula* 3·5 mm. longa, glandulosa et pubescens. *Semina* 2·5 mm. longa.

Mascarene Islands. Aldabra, *Fryer* 92.

1630. **Widdringtonia dracomontana,** *Stapf* [Pinaceae]; a *W. cupressoidi*, Endl., differt valvis fructuum ubique rugosis, ovulis 3-nis cum quaque squama, seminibus minoribus utrinque aequaliter alatis magis minusve oblongis.

Arbor mediocris vel *frutex*, *ramulis* gracilibus. *Folia* plantae adultae squamiformia, ea ramulorum ultimi ordinis arcte adpressa, superne in dorso subtumida, oblonga vel obvato-oblonga, subacuta vel fere obtusa, ad medium adnata. *Coni* ♂ oblongi, 2 mm. longi, squamis circiter 12 subpeltatis rhombico-ovatis subcoriaceis. *Coni* ♀ breviter spicati, tempore pollinationis 4 mm. diametro squamis ovato-oblongis subobtusis medio longitudinaliter valde incrassatis; maturi 1 vel 2 per spicam, globosi vel ovoideo-globosi, 1·8-2 cm. diametro, nigrescentes. squamis demum rugosis infra apicem tuberculo conico munitis. *Ovula* 3 cum quaque squama. *Semina* leviter compressa, oblonga vel lanceolato- vel ovato-oblonga, circiter 7 mm. longa, 3 mm. lata, atro-fusca, aequaliter alata, alis apice in excisura confluentibus, ad 2 mm. vel paulo ultra latis. *W. cupressoides*, Sim, For. Fl. Cape Col. 337 (pro parte); Bews in Ann. Natal Mus. iii. 549; non Endl. *Callitris cupressoides*, Wood, Handb. Fl. Natal, 122, and in Trans. S. Afr. Phil. Soc., xviii. 122, 224; non Schrad. *C. natalensis*, Endl. ex Fourcades, Rep. Natal For. 1889, 16, 121.

South Africa. Natal: Weenen District, Drakensbergen, headwaters of the Bushman's River (Langalibelele's Location), *Fannin* (*Sanderson*, 2011); between Cathkin and Mont aux

Sources, forming isolated woods or clumps at high altitudes, *Fourcades*.

Widdringtonnatalensis, Endl. Syn. Con. 34, very imperfectly described from specimens said to have been sent by Gueinzius and Krauss from "Port Natal," is very likely *W. cupressoides* from the Cape of Good Hope.

XXII.—FUNGI EXOTICI: XXIV.

In the present contribution nine species which appear to be new to science are described. One, *Fomes pseudo-ferreus*, is the cause of a serious root disease of *Hevea brasiliensis* in the Federated Malay States. This disease was originally attributed to *Poria hypolateritia*,* but material received at Kew shows that the fungus is a pileate species, and apparently an undescribed species of *Fomes*. Unfortunately the material available is imperfect, and perfect sporophores appear to be rarely formed. It has been judged advisable, nevertheless, to give the species a name for convenience of reference.

Fomes elegans was said to be found on living *Shorea robusta* but is not recorded as causing any great injury. Except for *Cercospora latimaculans* and *Puccinia Coreopsidis* the other species recorded are saprophytes.

Fomes elegans, *Wakefield.*

Pileus sessilis, tenuis, conchatus, postice decurrens, 4-6 × 2·5-3·5 cm., brunneo-griseus, zonis fusco-badiis concentricis notatus, demum rimosus rugulosusque, hymenio pallido concavo. *Contextus* aurantio-brunneus, 3-4 mm. crassus. *Tubuli* vix pallidiores, intus albido-farcti, 1-1·5 mm. longi. *Pori* minuti, tactu velutini, pallide roseo-cinnamonei. *Setulae* nullae. *Sporae* ex hyalino fulvescentes, late ellipticae vel subglobosae, 5 × 4-4·5 μ.

India. Singhbhum, on living *Shorea robusta* (the Sal), R. S. Hole (1916).

This is a small, neat species, with marked characters. The upper surface of the pileus when young recalls strongly-zoned specimens of *Polyporus licnoides*, while the pores in colour and softness to the touch resemble those of *Fomes dochmius*. The species differs from *F. dochmius* in the concave hymenium and in the bright orange-brown flesh. The colour of the latter is that of Ridgway's "Sanford's brown," while the colour of the pore-mouths is nearest to "light pinkish cinnamon." The pileus is thin for a *Fomes*, but shows stratification, each season's growth being about 5 mm. in thickness.

* Belgrave, W. N. C. Root Disease of Plantation Rubber in Malaya; in Ag. Bull. Fed. Malay States iv. 1916, p. 11.

Fomes pseudo-ferreus, *Wakefield.*

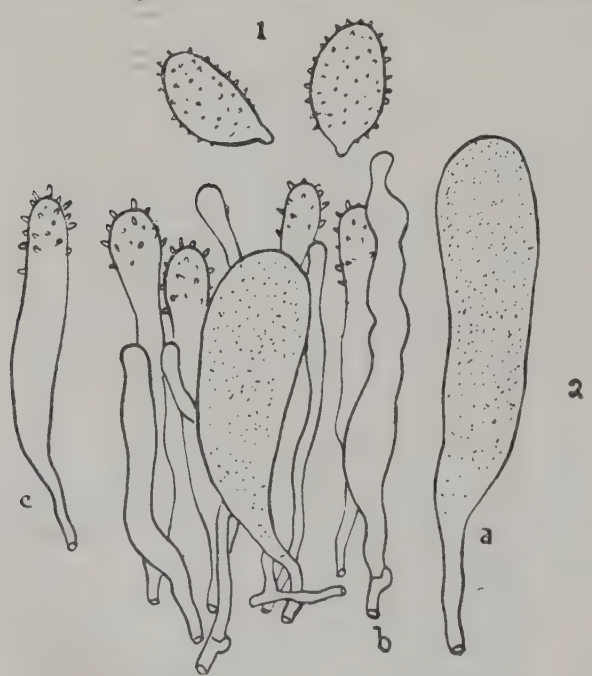
Pileus sessilis, dimidiatus, ungulatus vel irregulariter undulato-applanatus, subinde imbricatus, glaber, azonatus, cute rigida sicco rimosa e ferrugineo fusco-umbrina tectus, margine sterili tumido albido. *Contextus* floccosus, e cinnamomeo umbrinus. *Tubuli* concolores, intus albidi. *Pori* minuti, rotundati, crasse tunicati, albidi, tactu flavescentes. *Sporae* non visae.

Federated Malay States. On diseased *Hevea brasiliensis* roots, *W. N. C. Belgrave* (1917).

The fungus is said to cause a root disease of *Hevea*. Unfortunately mature sporophores are very rare, and the only one available, from which the above description has been drawn up, is ill-formed and shows no spores. When properly developed fructifications are obtained the description will no doubt have to be revised, but as the species does not appear to agree with any known form, and some means of designation is necessary, it has been thought advisable to name it. The very young sporophores, both in nature and as obtained in pure culture, strongly suggest a *Ganoderma*. One of the cultures, however, was said to have been obtained from hyaline spores derived from a resupinate fructification, hence the plant cannot belong to this genus. The mature pileus bears a distinct resemblance, as regards colour and texture, to that of *Fomes ferreus*, but it differs from that species in the white pore-mouths and darker flesh.

Aleurodiscus australiensis, *Wakefield.*

Sporophora primo irregulariter rotundata, demum late confluentia, hymenio roseo sicco alutaceo sub lente pulverulento, margine albido undulato secedente. *Basidia* juvenilia clavata, intus roseo-oleoso-guttulatae, 60-70 × 20 μ; basidia matura jam collapsa. *Pseudophyses* undulatae vel submoniliformes, apice obtusae, 50-80 × 7-8 μ. *Dendrophyses* cylindricae, apice obtusae, superne acuticae, utrinque angustiores, uno latere subcompressae, aculeatae, 24 × 15 μ. *Hyphae basales* arcte, *subhymeniales* laxe intertextae, septatae ad septa nodosae, 2·5 μ diametro. *Sporae* hyalinae, ellipleatae, 50-60 × 7-8 μ.



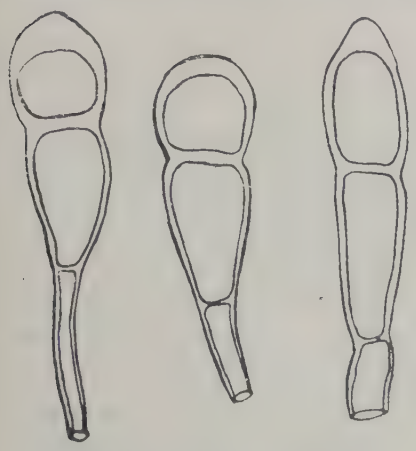
1. Spores. 2. Portion of hymenium showing *a*. Young basidium, *b*. Pseudophysis, *c*. Dendrophysis (× 550).

Australia. Queensland, on a dead branch, *C. T. White* (1912).

In habit this species resembles *A. javanicus*, P. Henn., but it differs in the rough spores, and in the presence of wavy or moniliform paraphyses (Pseudophyses) in addition to the aculeate paraphyses (Dendrophyses).

Puccinia Coreopsidis, *Wakefield.*

Maculae griseae, suborbiculares, 3-4 mm. diametro, definite limitatae, atro-marginatae. *Teleutosori* hypophylli, plus minus concentrice dispositi, aggregati confluentesque, circa 0·5 mm. diametro, diutius epidermide tecti, demum erumpentes, spadicei. *Teleutosporae* pallide fulvescentes, variabiles, clavatae, medio constrictae, apice rotundatae, ad 7 μ incrassatae, loculo superiore subgloboso vel elliptico 18-30 × 16-20 μ, loculo inferiore cylindrico vel clavato 28-35 × 10-18 μ; pedicellus fulvus, 10-35 × 5-7 μ.

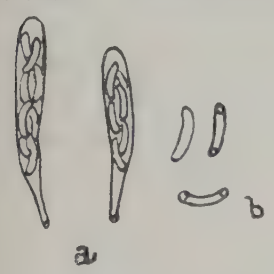


Teleutospores (× 550).

Tropical Africa. Uganda, on *Coreopsis* leaves, *R. Dummer* 1113 (1914).

Eutypella theobromicola, *Wakefield.*

Stromata elongata, per fissa erumpentia, circa 6 mm. longa, atra. *Perithecia* in quoque stromate dense aggregata, 0·25 mm. diametro, collis 6-sulcatis 0·5 mm. longis. *Asci* clavati, 22-25 × 3·5-4 μ, octospori. *Sporae* subdistichae, elongatae, curvulae, pallide olivaceae, 6-7 × 1-1·5 μ.



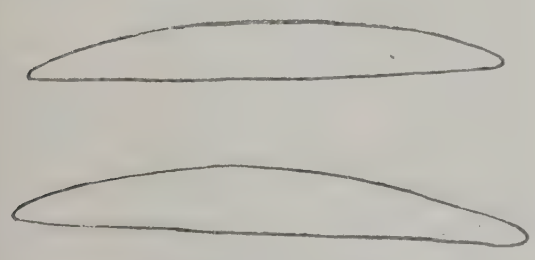
a. Asci.
b. Spores (× 850).

Tropical Africa. Gold Coast; Koshea, on *Theobroma Cacao* stems, *A. C. Miles* (Dec. 1915).

Rosellinia asperata, *Mass.* MS. in Herb. Kew.

Subiculum late effusum, pannoso-crustaceum, fusco-brunneum. *Perithecia* conoidea, 0·75-1 mm. diametro, 1 mm. alta, subiculo primo tecta, dein semi-immersa, villoso-aspera, ostiolo conico atro-nitente. *Asci* jam absorpti. *Sporae* fuscae, fusiformes vel cymbiformes, rectae, utrinque acutae, 50-60 × 7·5-8 μ.

Gold Coast. Aburi, on rotten wood, Botanic Gardens, *W. H. Johnson*, 178 (1900).



Spores (× 850).

This species resembles in habit *R. bothrina*, B & Br., and *R. arcuata*, Petch, but differs in the larger spores. No mucous envelope can be observed in the spores of the type specimen which, however, is obviously old and not in the best condition.

Septoria Coffeae, *Wakefield.*

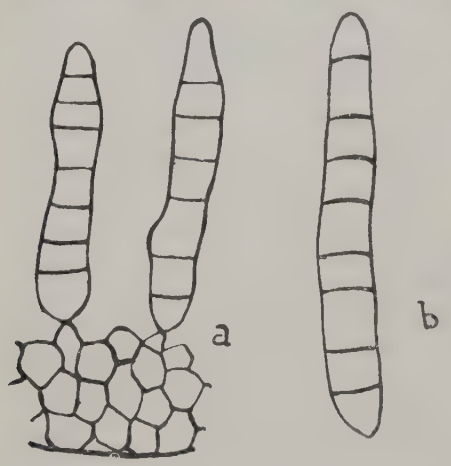
Pycnidia sparsa, globosa, 50-70 μ diametro, pariete pseudoparenchymatico, ostiolo pertuso. *Conidiophora* non visa. *Conidia* olivacea, cylindrica vel subfusiformia, curvula, 3-4 septata, 20-25 × 3 μ.

Conidia (× 850).

Tropical Africa. Uganda, on the torn parts of coffee leaves damaged by hail, *W. Small* 480.

Hendersonia Protearum, *Wakefield.*

Maculae nullae. *Pycnidia* amphigena, sparsa vel aggregata, immersa, globosa, 140-290 μ diametro, contextu parenchymatico obscure brunneo crassiusculo, ostiolo minuto papillato pertusa. *Conidiophora* brevissima, papilliformia. *Conidia* ubique in pycnidio oriunda, obscure brunnea, 3-7 (rarius-8) septata, curvula, utrinque attenuata vel elongato-obclavata, 25-52 × 6-8 μ, maturitate copiose emergentia et matrice inquinantia.



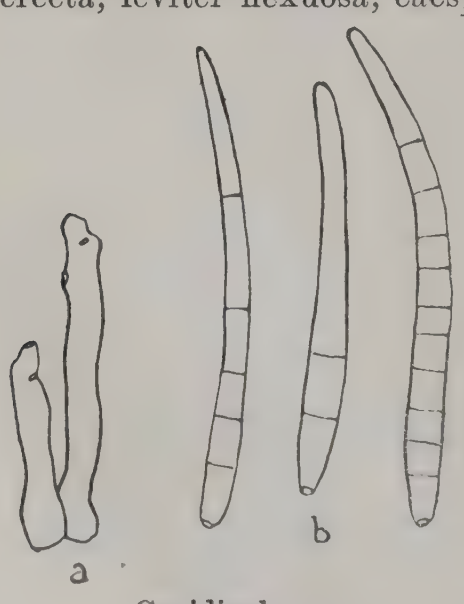
a. Portion of pycnidial wall with two conidia in situ.
b. Mature conidium (× 850).

Tropical Africa. Uganda, on dead *Protea madiensis* leaves, *R. Dummer* 2866 (July, 1916).

Remarkable for the very large spores, which when exuded form a black crust on the leaf for some distance round the ostioles.

Cercospora latimaculans, *Wakefield.*

Maculae utrinque visibiles, irregulares, angulosae, primo 2-3 mm. diametro, sed demum late confluentes, pallide brunneae, centro arescentes, margine purpureo-brunneo. *Acervuli* epiphylli, sparsi, punctiformes, atri. *Conidiophora* simplicia, continua, erecta, leviter flexuosa, caespitosa, fusca, 25-40 × 4-4·5 μ. *Conidia* elongato-obclavata, sursum paullatim attenuata, basi rotundata, leviter curvula, olivaceo-fusca, guttulata, 5-11-septata, ad septa non constricta, 30-65 × 2-5 μ.



a. Conidiophores.
b. Conidia (× 850).

Tropical Africa. Gold Coast; Aburi, on *Bauhinia* leaves, *R. H. Bunting* 93 (Mar. 1917).

This species differs from *C. Bauhiniae*, Syd., in the larger confluent spots, in the acervuli occurring on the upper surface of the leaf only, and in the longer conidiophores and darker and more septate conidia.

XXIII.—A NEW MECONOPSIS FROM YUNNAN.

D. Prain.

In an interesting letter to Kew, dated 30th October, 1917, Mr. George Forrest has enclosed for identification two specimens of *Meconopsis*, representing the only two species found during the season 1917, that are novelties to him.

Regarding one of the two the letter, which is written from the Upper Mekong in North-west Yunnan, says:—"The species in fruit of which I can send only a portion was collected by my man whilst securing seed of *M. speciosa*, and it may prove only a form of that species." As neither flowers nor leaves are present it is not possible yet to identify the plant. The material sent shows that the species is a member of the group *Aculeatae* (*K.B.* 1915, p. 144). The capsules show, however, that it is not *M. aculeata*, Royle, *M. latifolia*, Prain, or *M. sinuata*, Prain, and that it is neither *M. horridula*, Hook. f. & Thoms., nor *M. rudis*, Prain. The capsules are like those of *M. Prattii*, Prain, but this latter species has not so far been collected in the region to which *M. speciosa*, Prain, appears to be confined; comparison with the capsules of *M. speciosa* is impossible, as the ripe fruits of that species are not yet known.

It may be remarked incidentally that in the letter under notice, Mr. Forrest announces the rediscovery of a *Meconopsis* (his n. 13169) first met with by him in 1914. The specimens of that gathering are in fruit only and the capsules are not distinguishable from those of *M. integrifolia*. Mr. Forrest alludes to it now as "a smaller plant in every way than the type *M. integrifolia*, with all parts, especially the capsule, heavily clothed with long, shining, straw-coloured bristly hairs. The flowers are white, smaller than *M. integrifolia*. It is apparently a rare form, for I only saw a few specimens of it in one locality, on the Hom-pu Shan, which is a spur of the Bei-ma Shan, both being portions of the Mekong-Yangtze divide in Lat. 28° 12′ N.; very exposed rocky situation at approximately 14,000 ft." No plants raised from the 1914 seed of this plant have been reported at Kew. It is to be hoped that greater success may attend the seeds collected in 1917.

Mr. Forrest, in this letter, further states that "*M. integrifolia*, as seen on the Bei-ma Shan differs materially from the type found in the other ranges to the south and west in this province. The plants are taller, flowers larger, borne on stouter stems, the inflorescence almost apical, seldom branched from mid-stem, never from the base. The capsules are much larger and narrower and almost devoid of hairs." Growers of *Meconopsis* will look forward with interest to the results of sowing the seeds of this Bei-ma Shan plant. The old problem, with regard to the differences between the true *M. integrifolia*, Franch., and the very distinct species, which in externals so closely resembles *M. integrifolia*, first raised from seed secured by Captain Koslov in Kham, will suggest itself to those interested, as Mr. Forrest is, in this genus. Among the species of which seeds have been

obtained during 1917, Mr. Forest mentions, in addition to those already noted by him, *M. Henrici*, Bur. & Franch., and *M. lancifolia*, Franch.; he also alludes to a form allied to *M. lancifolia* and adds the interesting remark:—"so far I have not found *M. rudis* in this area."

The most interesting, from the botanical and distributional standpoint, of the species alluded to in this letter, is that represented by the second specimen—a flowering one—therein enclosed. The species it represents, besides being new to Mr. Forrest, is new to the genus. It belongs to the section *Eumeconopsis*, in all the species of which any hairs that may be present are simple, not barbellate. Within that section its place is in the group *Cumminsia* (*K.B.* 1915, p. 142), and in that group it stands intermediate between *M. lyrata*, Fedde, a rare Sikkim plant and *M. polygonoides*, Prain, an equally rare plant from Chumbi, resembling the former very closely as regards its foliage and being at first sight hardly distinguishable from the latter as regards its flowers. It agrees with both these Himalayan species in the colour of its petals, but differs from them both in having half as many more stamens—24 in place of 16. Ripe capsules not being yet available, neither these nor the seeds can be described. The material supplied is, however, otherwise adequate for purposes of diagnosis, and the necessary formal account of the species is appended. Its place in the group to which it belongs will be most readily appreciated from the modification required in that portion of the 'Key to the known species of Meconopsis' (*K.B.* 1915, p. 137 et seq.) relating to *Cumminsia*, which the existence of this plant involves (l.c. p. 138).

Flowers blue or purple; leaves hirsute:—
  Leaves hastate entire, or lyrate-pinnatifid:—
    Petals ovate, rounded or rarely acute, fimbriate; stamens 16 ... ... 4. *lyrata.*
    Petals ovate-lanceolate, acute, entire; stamens 24 ... ... 4a. *compta.*
  Leaves ovate-lanceolate, more or less incised-crenate:—
    Petals ovate-lanceolate, acute; stamens 16 ... ... 5. *polygonoides.*
    Petals rounded, obtuse; stamens 64 ... 6. *betonicifolia.*

Meconopsis compta, *Prain*; species e grege *Cumminsia* nuncupato inter *M. lyratam*, Fedde, et *M. polygonoidem*, Prain, quoad folia quasi medians ab ambabus tamen staminibus 24 nec 16 facillime distinguenda.

Herba perennans, inermis. *Rhizoma* anguste ovoideum, oblique descendens, 1·5 cm. longum, 0·5 cm. latum. *Folia* plerumque radicalia vel prope basin et secus trientem imum scapi disposita, oblonga et lyrato-pinnatifida, apice obtusa, basi late cuneata vel fere truncata ibique abrupte in petiolum anguste alatum basi caulem amplectentem abeuntia, supra saturate

viridia, subtus glaucescentia, utrinque sparse hirsuta, 2-2·5 cm. longa, 1-1·5 cm. lata; petiolus 2·5-3 cm. longus. *Scapus* centralis, 8-22 cm. altus, parce hirsutus, florem terminalem suberectum suffulciens scapis axillaribus subbasalibus simplicibus 1-floris additis. *Sepala* 2, anguste ovata, extra parce hirsuta, 0·8 cm. longa. *Petala* 4, ovato-lanceolata, apice rotundato in acumen abbreviatum acutata, 2 cm. longa, 1 cm. lata, pallide coerulea. *Stamina* 24 filamentis coeruleis; antherae aurantiacae. *Ovarium* anguste ovoideum, glabrum; stylus perbrevis; stigma capitatum lobis decurrentibus contiguis.

South-eastern Tibet: Sarong; in open stony pastures on Ka-gwr-pu, on the Mekong-Salwin Divide, Lat. 28° 25′ N., at altitudes of 3600-3900 m., *Forrest* 14306 (July, 1917)!

XXIV.—MISCELLANEOUS NOTES.

Edward Benbow, Capt.—We record with regret the death of Captain E. Benbow, M.C., R.A.F., only son of Mr. J. Benbow, head gardener of the celebrated gardens at La Mortola, Italy, who was killed on May 30, 1918, while contending single-handedly against four or five enemy aeroplanes.

Captain Benbow joined the army in September, 1914, and after obtaining a commission in the Royal Artillery transferred to the Royal Flying Corps, where he gained the reputation of a brave and intrepid airman.

R. H. Pearson.—The widespread sorrow occasioned by the death of Mr. Robert Hooper Pearson, the Managing Editor of the *Gardeners' Chronicle*, which took place on June 11, is shared by his many friends at Kew where, about thirty years ago, he was a member of the gardening staff. Born at Brewood in Staffordshire on July 18, 1866, Pearson came to Kew in 1889 and was soon promoted to a sub-foremanship. Leaving in March, 1890, he entered the gardens of the Marquis of Bute at Cardiff Castle, and afterwards spent some time in the gardens at Patshull Hall, Staffordshire. In 1892 he was invited by Dr. M. T. Masters, then Editor of the *Gardeners' Chronicle*, to join his staff. He became Assistant-editor, and about ten years ago was appointed Managing Editor. Though ardently devoted to his main work he found time for other activities in connection with horticultural interests, and in addition to contributing articles to other papers he wrote a useful little book on Garden Pests and edited the several excellent volumes forming the Present Day Gardening series. In 1911 he was President of the Kew Guild and an appreciative notice of him, with portrait, appeared in the Guild Journal for 1909-10. The *Gardeners' Chronicle*, 1917, vol. lxi, p. 214, and 1918, vol. lxiii, pp. 246 and 256, gives further particulars of Mr. Pearson's life and work and expresses the great affection and esteem with which he was regarded by his colleagues and friends.

Edward Alexander Newell Arber.—The untimely death at Cambridge on June 14th, 1918, of Dr. E. A. Newell Arber, at the age of 47, has been a source of deep regret to his friends at Kew. Although the bulk of his work has been concerned with systematic palaeontological study and thus did not bring him directly in contact with the work of Kew, his interests were by no means confined to that particular field, but led him, in one direction, to the presentation of a reasoned conception as to the origin of flowering plants; in another, to the preparation of an account of the natural history of alpine plants. In both of these activities Kew has been under obligations to Dr. Arber and those here who knew him are the poorer for the loss of his friendship.

Hibiscus cannabinus in Nigeria.—This is the most important species of *Hibiscus* grown for the production of fibre on a commercial scale. It is cultivated in India, the Madras Presidency being the centre of the trade; in Java; the Philippines; Persia; Nigeria; French Senegal, &c. The fibre has been dealt with as "Ambari" or "Ambasi," "Deccan," "Indian" or "Kanaff" (Capsian Sea) Hemp, "Hemp-leaved *Hibiscus*," "Bastard Jute" and "Bimlipatam Jute" in *Kew Bull.* Add. Series ii. "Vegetable Fibres," 1901, pp. 9-11 and Add. Series ix. 1908, pp. 70-71. In the last mentioned issue, "Ramma" or "Rama" (Hausa) is attributed only to *Hibiscus lunariifolius*, Willd., but on specimens in the Herbarium (*Dalziel*, Nos. 63, 425) since received at Kew from Northern Nigeria the particulars given go to show that *Hibiscus cannabinus*, Linn., is the commonly cultivated "Rama" of Nigeria; in Katagum it is cultivated near huts for fibre. A specimen collected by Higginson, Lagos, gives the same native name and a specimen of *H. lunariifolius* (*Foster*, Lagos) called "Ramo" or "Yemoro" also indicates that the same native name may apply to more than one species. "Wild Rama" has been applied to *H. asper*, a species described in *Kew Bull.* 1913, p. 418.

As well as being an important cultivated plant in Nigeria, *H. cannabinus* is cultivated on the banks of the Niger and the Bani by the Somono people.* The fibre is only produced for local use, but it is suggested that if the cultivation were increased the exportation of the fibre would be very remunerative. Some experiments made in the Segu district in rich soil on the banks of the Niger gave a yield of 8400 kilos of dry stalks and of fibre 1596 kilos of fibre per hectare. On a field in poor soil the yield was found to be 7000 kilos dry stalks and 1316 kilos of fibre per hectare.

In general the fibre is regarded as an efficient substitute for "Jute" (*Corchorus capsularis*) in the manufacture of cordage, sacking or any of the coarser textiles.

The seeds yield an oil to which some attention was drawn in

* *See* a note on "the 'Da Fou' in Upper Senegal and on the Niger," quoted in The Inter. Review of the Science and Practice of Agriculture, Rome, viii. Nov. 1910, p. 69, from Bull. de l'Office Col. Paris, No. 29, 1910.

"L'Agronomie Coloniale: Bull. Mensuel du Jardin Colonial," No. 6, December, 1913, by J. Vuillet. It is described as a drying oil of a pale yellow colour which might find a market in the colour and varnish, linoleum industries, &c., and the cake suggested as a possible food for cattle. According to Watt (Comm. Prod. India, p. 631) the seeds yield a clear limpid oil; they have been sent to England as an oil-seed and they are used in Poona as a cattle food.

Specimens of the fibre and oil from India and fibre from West Africa, including French Senegal (sample of "Da") are in No. 1 Museum. J. H. H.

Jubaeopsis caffra.—A palm known as "Inkomba" was discovered in 1909 in East Pondoland, at the mouths of the Umsikaba and Umtentu Rivers, by Mr. Charles Ross, then Conservator of Forests at Umtata. Specimens received at Kew through the South African Museum were submitted to Dr. O. Beccari, who regarded them as belonging to a new genus, of which he published an account, under the name of *Jubaeopsis*, in Webbia, vol. iv, pp. 169-176 (1913), and in Agric. Colon. Ital. x, p. 531, t. 13 (1916). *Jubaeopsis* can be diagnosed from its allies, *Jubaea*, H.B. & K., a monotypic Chilian genus, and *Cocos*, L., thus:—

Jubaea. Stamens numerous. Calyx of male flowers 3-partite, tapering into the pedicel. Endocarp with 3 pores just below the middle.

Jubaeopsis. Stamens 9-16. Calyx of male flowers of 3 free sepals imbricate at the base. Endocarp with 3 pores above the middle.

Cocos. Stamens 6. Calyx of male flowers of 3 free sepals imbricate at the base. Endocarp with 3 pores at the base.

Jubaeopsis caffra, *Becc.* (l.c.), is a tree with a trunk about 20 ft. high, bearing a crown of pinnate leaves 12-15 ft. long, amongst which the spadices arise and produce female flowers on the lower parts of their branches, and male on the upper. The globose fruit, about 3 cm. in diameter, has a yellow fibrous pericarp surronding a thick woody endocarp enclosing a central cavity, which, according to Dr. Marloth (Fl. S. Afr. iv. p. 48) is empty, but according to Mr. I. B. Pole Evans, Chief of the Division of Botany, Department of Agriculture, Union of South Africa, who has recently collected fresh ripe nuts, contains "milk just like the ordinary coconut." Dr. Beccari believes that plate 164 in Martius' Historia Naturalis Palmarum, erroneously called "*Phoenix reclinata*," represents this plant; it is a reproduction of a drawing of a scene on the Fish River and was sent to Martius by Ecklon.

With the exception of the widely spread *Cocos nucifera*, L., this is the only representative of the *Cocoineae* in the Old World. C. H. W.

Lord Howe Island.—Mr. W. R. B. Oliver, in the Transactions of the New Zealand Institute, vol. xlix. pp. 94-161 (1917), contributes an interesting paper on the vegetation of this island, based mainly on collections, notes and photographs obtained during a stay of fifteen days during November, 1913. Mr. Oliver gives an account of the physiography, climate, and the characteristic plant formations, some of which are illustrated by photographs. The origin of the flora is discussed both from a consideration of the geological history of the island in regard to its probable past land connections with New Zealand, New Caledonia and Australia, and from the affinities of its plants with those from surrounding areas. There are 209 vascular plants known to occur in the island, and to the records of previous collectors Mr. Oliver adds only one species, the widely spread *Kyllinga monocephala*, Rottb., and that is probably a recent introduction. As in most oceanic islands a large proportion of the arboreal vegetation is endemic, in this case 70 per cent. Only 4 of the 169 genera are endemic, two of these being related to New Zealand forms, one to New Zealand and New Caledonian genera, and the fourth (*Howea*) to Malayan and Tropical Australian types. Of the non-endemic genera, 95 are widely distributed and 47 have a wide range but do not occur in New Zealand. Seventy species (about 33 per cent.) are endemic. The Polynesian and New Zealand elements in the endemics are more pronounced than are the Australian, but the latter is more evident in the case of the non-endemic. Considering both the fauna and flora of the island and the present contour of the ocean bed, Mr. Oliver concludes that the forms now existing there originated mainly as an early migration along a former New Caledonian-New Zealand land line, the last land connection having been with the former island. The presence of distinct species of such typical New Zealand genera as *Olearia* and *Coprosma* is noteworthy.

Lord Howe Island would appear to provide ideal material for the study of the "Age and Area" hypothesis recently propounded by Dr. Willis. Mr. Oliver's opinions are shown in a paragraph on "Endemism," and scarcely coincide with Willis's theory, for he bases his conclusions on the "working hypothesis that those species longest in the land will comprise the largest proportion of endemic forms and the highest degree of peculiarity, while the presence of widely distributed species indicates that dispersal is probably still going on ,and this in the case of an oceanic island leads one to conclude that no direct land connection is required to explain their occurrence."

The genera are arranged after Engler's system, but it is regrettable that in this valuable contribution the space occupied by the double quotation of the binominals was not used for the names of the families, which are omitted. A new species of *Coprosma* (*C. prisca*), formerly confused with the Norfolk Island *C. Baueri*, Endl., is described in the paper, which concludes with a list of works dealing with the natural history of the island. J. H.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 7] [1918

XXV.—CORDIA MYXA AND ALLIED SPECIES.

J. Hutchinson.

An enquiry addressed to Kew respecting the distribution of *Cordia Myxa*, L., has rendered necessary a critical examination of the herbarium specimens referred to that species. According to various authorities *Cordia Myxa*, L., enjoys a wide distribution, ranging from the Zambesi delta in Africa, through Egypt and Palestine to Cochin-China and Tropical Australia. We find that this is not the case, and that *Cordia Myxa* is in all probability confined to Asia Minor and Egypt, where it is mostly found in cultivation.

In order to define the true *C. Myxa*, we must begin with Linnaeus's description of the plant in the Species Plantarum (1753). Under *Cordia Myxa* (vol. i. p. 190), there are quoted a number of synonyms, the earliest of which is the "Sebesten sylvestris & domestica" of Alpini,* De Plantis Aegypti (1592). Alpini describes and figures two plants, "Sebesten domestica," with ovate, rounded, entire leaves, and "Sebesten sylvestris" with ovate-oblong, crenulate leaves. He gives an account of the local methods of preparing birdlime from the fruits of both kinds, and also their uses in medicine for various affections of the throat and chest. These species are no doubt *Cordia Myxa*, L., and *Cordia crenata*, Del., respectively.

The next authority quoted by Linnaeus is Bauhin, Pinax, p. 446 (1623). Bauhin also, like Alpini, distinguishes the same two species, and in addition he gives a number of references to more ancient literature which need not concern us in the present paper. Following this Linnaeus mentions Rheede's Hortus Malabaricus, vol. ix. p. 77 (1689), wherein is described an Indian plant under the name of *Vidi-maram*. Rheede says that it occurs at various places in Malabar, especially in marshy situations around Bardella. Rheede's plant is a distinct species, *C. obliqua*, Willd., widely spread in India and Malaya, and occurring also in Mauritius, but probably there introduced. Linnaeus also quotes

* Linnaeus does not quote the earliest edition of Alpini (1592), but evidently refers to the edition of 1640, p. 30.

(5505.) Wt. 196—794. 1,125. 11/18. J. T. & S., Ltd. G. 14. Sch. 12.

Commelyn, Horti Medici, p. 139, fig. 72. This seems to be a picture rather of the Indian plant than of *C. Myxa* proper.

In the Hortus Cliffortianus, p. 63, Linnaeus, under the name "Cordia foliis subovatis serrato dentatis" united the plants recognised as distinct by Alpini and Rheede, remarking "Auctores specie distinguunt domesticum seu cultam arborem a sylvestri quod mihi paradoxon est." By failing to distinguish the three species, however, the "paradox" seems to have been of Linnaeus's own making. His Materia Medica, p. 57 (1749), the latest quoted work, fortunately does not add to the confusion. It seems clear, therefore, that Linnaeus in the Species Plantarum confused no less than three species, (1) *Cordia Myxa* (emend.), the "Sebesten domestica" of Alpini and "Myxa" of the Ancients, (2) *Cordia crenata*, Del., the "Sebesten sylvestris" of Alpini, and (3) *Cordia obliqua*, Willd., the "Vidi-maram" of Rheede's Hortus Malabaricus. The specimen in Linnaeus's herbarium at the Linnean Society is the real *C. Myxa*. It is marked as having been grown in the Upsala garden.

Of the post-Linnean authors, the best account of *Cordia Myxa* is given by Delile, Flore d'Egypt, 47, t. 19 (1812). Delile gives beautiful and accurate figures of *C. Myxa* and *C. crenata*, and states that both species are cultivated in the gardens of Cairo.

I have tried without success to segregate the specimens referred to *C. Myxa*, L., and *C. obliqua*, Willd., by C. B. Clarke in the Flora of British India (vol. iv. pp. 136-7), and have come to the conclusion* that only one rather variable species is represented. The young and mature leaves of many of the specimens from the same localities have frequently a very different appearance, but the difference appears to be if anything merely seasonal. According to a note by Wight the plant "is a very common shrub or small tree. . . . It is, I think, a male or a hermaphrodite at different seasons of the year—at some seasons, say, from March till about May when covered with flowers, it is difficult to find a perfect one, all being males; but a few months afterwards it flowers again and every flower is perfect but much fewer in number than before." According to Post. Fl. Syria, &c., p. 532 (1896), the cymes of *C. Myxa* are also polygamous.

The specimens referred to *C. Myxa* in the Flora of Tropical Africa (iv. pt. ii. 14) are *C. Goetzei*, Gürke. It differs from *C. Myxa* in its membranous, obovate, cuneate, glabrous leaves, slender pedicels and style arms, and probably much smaller fruits. We have seen no true *C. Myxa* from Tropical Africa except from the French Sudan, where it is cultivated around the native villages (*Chevalier*).†

As stated above, the mucilaginous pulp of the fruits of *Cordia Myxa* has been used as a birdlime from very early times; it is now supposed to be used in the manufacture of unpuncturable motor tyres.‡ The localities in the Orient where it is known to

* Cooke (Fl. Bomb. ii. 199) came to the same conclusion and referred all he Indian specimens to *C. Myxa*, L.

† Bull. Soc. Nat. d'Accl. Fr. 1912, 135.

‡ *fide* Holland, Useful Plants of Nigeria, Kew Bull. Add. Ser. ix. pt. iii. 471.

grow are set out in detail below. In most of these regions the fruits are probably ripe about the end of June.

Key to Cordia Myxa and its related species.

Style arms short and broad, expanded fanwise towards the apex and with lobulate margins (see fig. 1, A); leaves always more or less orbicular, entire or obscurely repand in the upper part, always lightly covered all over the lower surface with white short setulose hairs, flabellately 5-7-nerved from the base; anther-filaments nearly glabrous at the base	*C. Myxa*, L. (emend.)
Style arms long and slender and only sometimes slightly expanded at the apex (see fig. 2); leaves variable but usually penni-nerved at the base, if hairy, then the hairs fairly long and mainly in the axils of the nerves and near the mid-rib; anther-filaments rather densely setose-pilose towards the base	*C. obliqua*, Willd.
Style arms long and slender, not expanded at the apex; leaves elliptic, crenate in the upper part, glabrous or nearly so, penni-nerved at the base; anther-filaments pilose towards the base ...	*C. crenata*, Del.

Cordia Myxa, *Linn.* Sp. Pl. i. 190 (1753), emend.; Amoen. Acad. iv. 452 (Fl. Palest.) (1756); Hasselq. It. 458 (1757); Delile, Fl. Aegypt. 47, t. 19 (1812), partim; Boiss. Fl. Orient. iv. 124 (1879); Post, Fl. Syria, Palest. et Sinai, 532 (1896); Chevalier in Ann. Inst. Col. Marseille, 1902, t. 3; et in Bull. Soc. Nat. d'Accl. Fr. 1912, 135; Muschler, Manual Fl. Egypt, 780 (1912); Holmboe, Veg. Cyprus, 146 (1914). *Prunus Sebestena,* Matth. Comm. ed. Valgris, 267 (1565). *Sebestena domestica* Alpini, De Plant. Aegypt. 12, t. viii. fig. 1 (1592); ed. 1640, 30, cum icon.; Pluk. Alm. t. 217, fig. 2 (1696). *Sebestena domestica* Bauh. Pin. 446 (1623). *Cordia sebestena,* foliis sub-rotundis, Forsk. Fl. Aegypt. lxiii. (1775). *Sebestena officinalis,* Gaertn. Fruct. i. 364, t. 76, fig. 1 (1788). *Cordia officinalis,* Lam. Ill. 420, no. 1895, t. 96, fig. 3 (this figure is reproduced from Gaertner).

Cyprus. Hagia Napa, "cultivated and subspontaneous for several centuries," *Holmboe* (l.c.)

Asia Minor. Mt. Taurus, *Kotschy,* 566; Suedieh, Gulf of Eskenderum, fruiting specimen without collector's name, in *Herb. Hook.* Palestine; hot plains around Jericho, June 9, 1911, in fruit, *Meyers & Dinsmore,* 5132.

EGYPT. Gardens of Cairo, Alexandria and Rosette, *Jomard* (Herb. Gay); *Sieber*; large tree in the Royal Vineyard at Scut, *Schweinfurth*, 1480, 1480B.

1. *Cordia Myxa*, L.; A. Style-arms; (shoot and fruits natural size; floral parts enlarged). 2. Style-arms of *Cordia obliqua*, Willd. (enlarged).

Arabia. Muscat, cultivated, *Aucher* 4965.

Tropical Africa. French Sudan; Moussaia (cultivated), *Chevalier*, 463; naturalised in villages of French and Nigerian Sudan, *Chevalier* (l.c.)

Boissier (l.c.) says that the tree occurs around Basra and in the island of Karrak in South Persia; it is known in Babylon as *Bombar*, and the fruit in Egypt as *Mokhayet*. Bornmueller* also observed the tree in Karrak in 1894.

According to Post (l.c.), the tree flowers from January to May, and is cultivated everywhere; he records it as being "spontaneous in Ghor (Palestine); the fruit is edible and is principally used for making birdlime; bark a tonic; wood used to kindle fire by friction; formerly used by Egyptians to make sarcophagi."

Muschler (l.c.) states that it is "cultivated in old gardens, often naturalised; abundant near Luksor and in the Great Oasis."

Cordia Myxa, var. *domestica*, C. B. Clarke (Fl. Brit. Ind. iv. 137) is no doubt a very distinct species and was described as such (*C. domestica*) by Roth. The very long beak of the berries, small few-flowered lateral inflorescences, small shortly petiolate repand leaves coated below when young with a mealy indumentum are its striking features.

Cordia obliqua, *Willd.* Phytogr. 4, t. iv. (1794); Sp. Pl. i. 1072 (1797); DC. Prodr. ix. 479 (1845); C. B. Clarke in Hook. f. Fl. Brit. Ind. iv. 137, excl. var. (1883); Watt, Dict. Econ. Prod. Ind. ii. 565. *C. indica*, Lam. Dict. vii. 49 (1806); DC. l.c. 500. *C. latifolia*, Roxb. Fl. Ind. ed. Car. & Wall. ii. 330 (1824); Dalz. et Gibs. Bomb. Fl. 173. *C. Myxa*, Roxb. l.c. 332; Wall. Cat. 889; Wight, Ill. t. 169; Dalz. et Gibs. l.c.; Benth. Fl. Austral. iv. 386; Bedd. For. Man. 165, et Fl. Sylv. t. 245, fig. A.; Brand. For. Fl. 336; Kurz, For. Fl. ii. 208; Thwaites, Enum. 214; C. B. Clarke l.c. excl. var.; Watt, l.c. 563; Gamble, Man. Ind. Timb. 500-501; Merrill, Interp. Rumph. Herb. Amboin. 447 (1917); non Linn. *Vidi-maram*, Rheede, Hort. Malab. iv. t. 37. For further references to literature and detailed information as to native names and uses, see Watt, ll.cc.

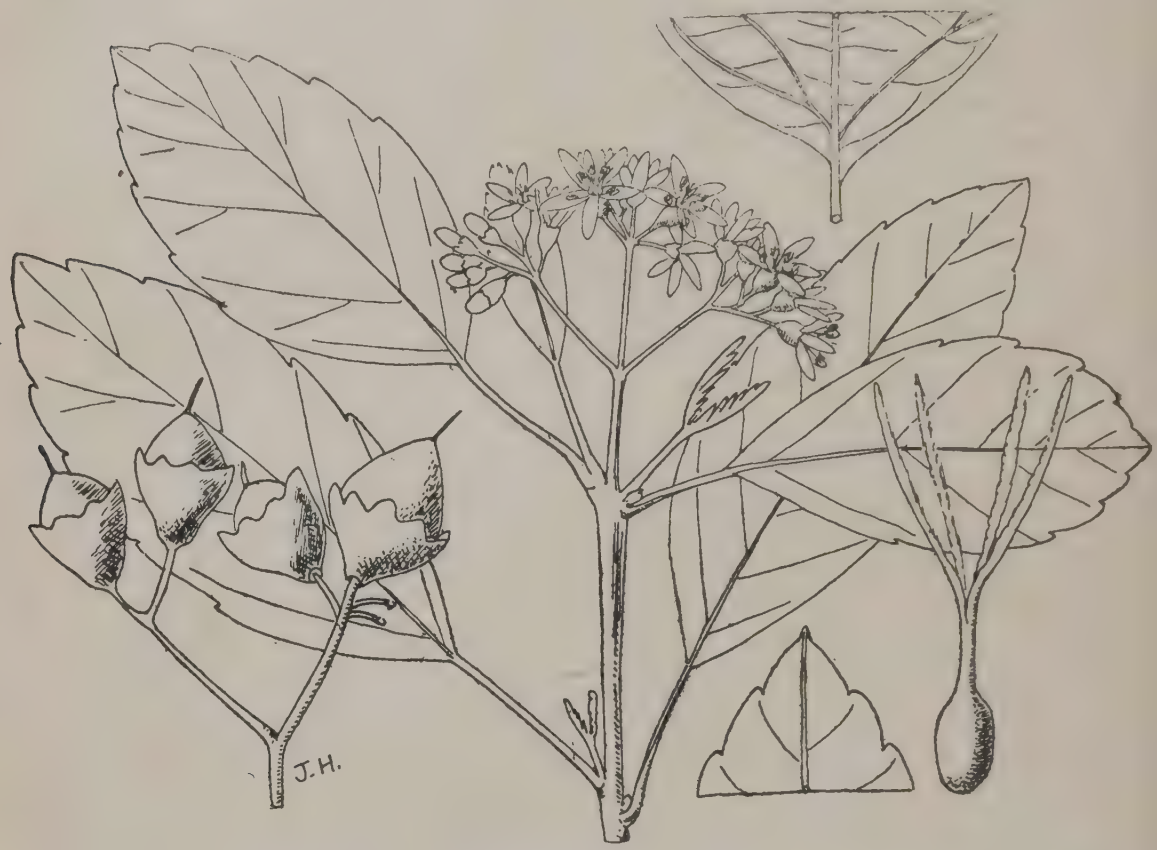
Widely spread over nearly the whole of the warmer parts of India and Ceylon (often cultivated), Malacca, Indo-China, Hainan, Formosa, Java, Philippines (*C. Blancoi*, Vidal), New Guinea and Tropical Australia.

Vernacular name of the fruit in India, *Lasora;* known to Anglo-Indians as *Sebesten.*

C. obliqua, var. *Wallichii*. C. B. Clarke (Fl. Brit. Ind. l.c. 137) is a distinct species (*C. Wallichii*, Don) and has been regarded as such by Talbot (Trees Bomb. ed. 2, p. 243) and Cooke (Fl. Bomb. ii. 200). It may be distinguished from *C. obliqua* by the rather densely tomentose buds and undersurface of the leaves.

* Mitt. Thüring. Bot. Ver. Neue Folge, Heft. vi. 57 (1894).

Cordia crenata, Delile, Fl. Egypt, 51, t. 20, fig. 1 (1813); DC. Prodr. ix. 479; Boiss. Fl. Orient. iv 124; Aschers. et Schweinf. Ill. Fl. Egypt, 108, no. 713; Muschler, Man. Fl. Egypt. 781. *Sebesten sylvestris,* Alpini, De Plant. Aegypt. 12, t. viii. fig. 2 (1592); ed. 1640, 31, cum icon. *Cordia Myxa* foliis serratis, etc., Forsk. Fl. Aegypt. p. lxiii. no. 136.



3. *Cordia crenata,* Del. Natural size, pistil enlarged (partly after Delile).

Egypt. Cultivated in gardens, and in places naturalised: local name *Mokhayet rumy* (c.f. Muschler, l.c.).

The Abyssinian specimens referred to this species in the Flora of Tropical Africa (vol. iv. pt. ii. p. 16) appear to be distinct. The young shoots and leaves are scabrid-puberulous and the flowers are apparently much larger. It should be known under the name *C. Bakeri,* Britten in Journ. Bot. xxxiii. 88 (1895).

XXVI.—THE FLORA OF MADRAS: II.

The issue of the first part (pp. 1-200) of the *Flora of Madras* was recorded in *Kew Bulletin,* 1916, at p. 57. We have now to announce the appearance of a second instalment (part 2, *Celastraceae* to *Leguminosae-Papilionatae,* pp. 201-390) which has been prepared by Mr. J. S. Gamble. It was arranged, when the commencement of the Flora was undertaken, that as explanatory notes were not admissible in the text, it would be well for any explanations to be given in separate notes. The first instalment of these notes was prepared by Mr. S. T. Dunn, who drafted the opening Families of the Flora and the notes have now been con-

tinued by Mr. Gamble. We are indebted to Mr. Gamble's courtesy for the opportunity of placing these on record for the information of workers in herbaria, relative to conclusions with regard to particular species dealt with in the work that differ from those arrived at by earlier writers.

Notes on the Flora of Madras.*

J. S. Gamble.

Menispermaceae.—Since the publication of Part I of the *Flora* specimens of the following two additional species have been received from Mr. A. W. Lushington from the Madgol Hills of Vizagapatam District, from about 3000 to 4000 ft. elevation.

Pericampylus incanus, Miers; F.B.I. i. 102.

Hypserpa cuspidata, Miers. *Limacia cuspidata*, Hook. f. & Th.; F.B.I. i. 100.

Hypericaceæ.—To the geographical distribution of *Hypericum mysorense* should be added "E. Ghâts, Madgol Hills of Vizagapatam at 4500 ft."

Rutaceae.—*Limonia crenulata*, Roxb., is the name which, as explained by Trimen in Journ. Linn. Soc. xxiv. 142, must be adopted for the plants recorded in the Flora of British India under the name *L. acidissima*, Linn., the actual specimens in Hermann's Herbarium, which are in leaf only, showing that they belong to *Feronia Elephantum*.

Ochnaceae.—An examination of the specimens in Wight's Herbarium shows that *Ochna Wightiana*, Wight, and *O. Heyneana*, Wight, are quite distinct. The former is a plant with small obtuse leaves, while the latter has oblong-lanceolate leaves. It is well figured in Wight, Ic. t. 288, but the description applies chiefly to *O. Wightiana*.

Meliaceae.—I have endeavoured, after careful examination of the good supply of excellent specimens in the Madras and Travancore Herbaria, to set right the difficulty I have always felt about the species of *Aglaia*. If Wight and Arnott's figure (Ic. t. 166) of their *Milnea Roxburghiana* be compared with Beddome's t. 130, which represents two branchlets, one from what he calls the common form, the other from a tree of the Tinnevelly hills, it must be at once recognised that they cannot refer to the same species. The plant figured by Wight is, of course, the true *A. Roxburghiana*, and some of the material available agrees well with it. Among Beddome's specimens in the Madras collection are some that have every appearance of being the exact ones from which his figure was taken, and these show that his 'B' variety, of which Bourdillon collected several good specimens in all stages, is a distinct species which I have therefore described as *A. Bourdillonii*. The 'A' variety of Beddome might also be easily considered distinct, but I have thought it best to describe it as var. *Beddomei* of *A. Roxburghiana*, W. & A. It is the most common form of the tree in the South Indian forests.

* Previous notes, by Mr. S. T. Dunn, appeared in *Kew Bulletin*, 1916, p. 58.

Celastraceae.

Kurrimia. Lawson, in the Flora of British India identified Beddome's *Trochisandra indica*, Fl. Sylv. t. 120, of which he had seen no specimens, with *Kurrimia paniculata*, Wall., and described a new species, *K. bipartita*, from specimens collected by Wight in the Sivagiri hills of Tinnevelly. Beddome's specimens in the Madras Herbarium agree with Wight's and are, I consider, distinct from *K. paniculata*. As Beddome's name is older than Lawson's, *K. bipartita*, Laws. must now give place to *K. indica*, Gamble, n. comb.

Elaeodendron. My own observations in the field and my collections, and my examination of Wight's and other specimens in the Madras Herbarium, convince me that Wight and Arnott were right in keeping separate *E. glaucum* and *E. paniculatum*. I am inclined to think that investigations in the field will show that there may be a third species characterized by small leaves drying green and very short cymes, but the material is at present insufficient.

Rhamnaceae.

Ventilago. I have spent some time over this genus and the excellent series of specimens available confirm in my mind the opinion I always held in the field that *V. calyculata*, Tul., is quite distinct and easily separable from *V. maderaspatana*, Gaertn. I have also described as new what I consider two species distinct from both: *V. Goughii* allied to *V. calyculata*, and *V. lanceolata* allied to *V. maderaspatana*.

Sageretia. After carefully examining the specimens at Kew and those in the collections placed at my disposal, I have come to the conclusion that *Sageretia parviflora*, G. Don, is distinct from the North Indian *S. oppositifolia*, Wall. Mr. T. A. Sprague, of Kew, very kindly went over the specimens with me and the difference appeared to us to be as follows:—*S. oppositifolia*, Wall. Leaves thick, long-acuminate; main-nerves up to 12 pairs, rather close (·3 to ·4 in. apart), strongly impressed on the upper surface where, too, the reticulation is inconspicuous. Thyrses contracted, united in a leafy subcylindric panicle with the rhachises and calyx-tube crispately white-villous; disk very narrow; flowers ·15 in. in diam. *S. parviflora*, G. Don. Leaves thinner, short-acuminate; main-nerves only about 5-6 pairs, more distant (·4 to ·6 in. apart), not impressed or with the lower ones impressed on the upper surface where the reticulation is easily apparent. Thyrses loose, either united into a pyramidal, almost leafless, panicle or terminating leafy lateral shoots, the rhachises merely puberulous, the calyx-tube glabrous; disk broader; flowers ·1 in. in diam. The oldest name for the South Indian plant seems to be *Rhamnus parviflora*, Klein; Roem. & Sch. Syst. v. 295 (1819); two years later (1821) it was described from Dr. Heyne's specimens in Roth, Nov. Pl. Sp. 153.

Gouania. I have included in the Madras Flora *G. leptostachya*, DC., though I have seen no specimens in Herbaria. I feel sure I have seen it growing in the N. Circars and the locality is given by Roxburgh and W. & A.

Vitaceae.

I have followed Planchon and Gagnepain in the arrangement of the genera, most of which were in the Flora of British India included under *Vitis*. I have followed Gagnepain in considering *Cayratia* as a genus and had finished my draft of the genus before I received vol. xi. part 3 of the Philippine Journal of Science, in which Dr. Merrill has pointed out that Loureiro's name *Columella* takes precedence (1790) of *Cayratia*. Though describing his species under *Columella*, Dr. Merrill gives reasons for thinking that *Cayratia* should be retained, and I have thought it best to adhere to that name and leave my descriptions as written under *Cayratia*.

Tetrastigma. There seem to be no available authentic specimens of *Vitis lanceolaria*, Roxb., but Roxburgh's drawing of the male plant copied in Wight, Ic. t. 177, gives its characters sufficiently well to convince me that Wight and Arnott were right in separating *V. muricata*, well figured in Wight, Ic. t. 740. I cannot agree with Planchon in placing *V. sulcata*, Laws., which has very well-marked leaves and large fruit, under *Tetrastigma lanceolarium*.

Ampelocissus. I have admitted to the Flora *A. divaricata*, Planch., on the strength of a specimen collected in the hills of Vizagapatam by Mr. A. W. Lushington. Unfortunately, it has leaves only, and the leaves are not easily distinguished from those of *A. tomentosa*. So many North Indian species extend to the hills of the Northern Circars that I think the occurrence of *A. divaricata* very likely and so I have admitted it.

Cayratia. *C. mollissima*, Gagnep. (*Vitis mollissima*, Wall.) is interesting as being a Malay species, also found in Malabar and the Nilgiris on the western slopes of the Ghâts. The Madras specimens differ only in the broader seeds, more crispate hairy branches and more deeply serrated leaflets. *C. auriculata* (*Cissus auriculata*, Roxb.) has been placed in *Cissus*, sect. *Cayratia*, by Planchon and has all the appearance of *Cayratia*. But the seeds differ, chiefly by the presence of vertical lobes in the albumen as in *Cissus*. It seems best to retain it in *Cayratia*, however, for the present at any rate, for the seeds do not resemble those of any other of our species of *Cissus*.

Leea. The Madras specimens of *Leea robusta* agree with those of Wall. Cat. 6826, collected in the Botanic Garden, Calcutta. But they do not agree so well with those figured in Roxburgh's plate No. 2043 which, however, only shows the uppermost and youngest leaves which have smaller and more lanceolate leaflets than ours have. *Leea aequata*, Linn., has been admitted to the Madras Flora on the strength of a specimen collected by myself in the Northern Circars, which agrees well enough with the Bengal and Burma specimens, except that there are many fewer of the flat round glands on the under-surface of the leaves.

Staphyleaceae.—Turpinia. *T. nepalensis*, Wall., as found in South India, seems to be identical, as Wight and Arnott considered, with the Himalayan tree, and in both localities it is a mountain species, very easily recognised in the forests. But I

am convinced that *T. pomifera*, DC. (*Dalrymplea pomifera*, Roxb. Cor. Pl. iii. t. 279) is only a tree of North Indian low levels and that the one found in the Western Ghâts and on the West Coast is distinct from it. I have therefore described it as *T. malabarica* (*Kew Bull.* 1916, 135).

Anacardiaceae.

Buchanania. I have followed Dr. Cooke in adopting the name *Buchanania Lanzan*, Spr., for the well-known *B. latifolia*. The identity of *B. intermedia*, Wight, Ic. t. 81, seems to be in some doubt. In the Flora of British India it is considered as a western variety of the eastern *B. lucida*, Blume, and Engler, in placing *B. lucida* as a variety of *B. florida*, Schauer, has made of *B. intermedia* another variety of the same. In the Madras Herbarium are many specimens from the Deccan Hills, including the Nagari Hills from whence Wight's plant came, which have thin leaves agreeing well in shape with those of Wight's figure. The flowers are, however, those of *B. angustifolia*, which sometimes has rather thicker leaves, and I think I am right in following Beddome and quoting *B. intermedia* under *B. angustifolia*.

Spondias. I have failed to find, among the specimens in the various Herbaria I have consulted, any that I think I can identify with Roxburgh's *S. acuminata*. Engler considered it entirely doubtful as a species, and I have thought it best to omit it from the Madras Flora. Trees which flower at the season when they are leafless are often very imperfectly represented in Herbaria and only those living on the spot near trees which they believe to be the right ones can collect specimens in all stages of flower, leaf and fruit, and settle such questions as this.

Nothopegia. This genus was founded by Blume in 1850 on the plant described by Wight in 1840 in Ill. i. 185 and Ic. t. 236 as *Pegia? Colebrookiana*. The specimen on which Wight's description and figure were based was collected by Wight in the "Shevagherry Hills" in Tinnevelly, in August, 1836, and is Kew Distribution No. 557. It has coriaceous, oblong or obovate, entire leaves with parallel main-nerves (about 15 pairs) and a short blunt acumen. They are 3-4 in. long and 1-1½ in. broad, with a stout petiole ¼ in. long. The inflorescence, which is in the fruiting stage, consists of axillary or lateral racemes about ¾ in. long, and the fruit is described as globose with an acute top ending in the persistent style and capitate stigma, in diameter ½ in. The pericarp is thick, full of oil-cells, and the seed has thick fleshy cotyledons with a basal radicle. Blume considered that the plant did not belong to the genus *Pegia*, founded by Colebrooke on the plant known as *Tapiria hirsuta*, Hook. f., transferred by Engler to *Phlebochiton extensum*, Wall. In the Flora of British India, Wight's Shevagherry specimens are described as *Nothopegia Colebrookiana*, Blume, var. *macrocarpa*, Hook. f., and the variety is accepted by Engler in DC. Monogr. iv. 468, who quotes, which Hooker did not, Wight, Ic. t. 236. But all the same, there cannot be any doubt that Wight's specimen, so far from being a variety of others, is the type of the species. It is a pity that both the genus

and the species should have been described before the flowers, either the male or the bisexual or both, were known. Among the material which I have available for the work on the Flora of Madras, besides Wight, K.D. 557, the only specimens which I believe belong to it are (1) some of Col. Beddome's, without locality, with male flowers in close racemes about 1 in. long, leaves up to 5 in. long with a longer acumination and rather more main-nerves and petioles $\frac{1}{2}$ in. long; and (2) a specimen collected by Lady Bourne on the Coonoor Ghát, Nilgiris, with ♂ flowers and leaves quite like Wight's. These I propose to call *Nothopegia Colebrookiana*, Bl.

In 1849, Dalzell described, in the Journal of the Asiatic Society of Bombay, iii. 69, a genus *Glycycarpus* and a species *G. racemosus*, the specific name having been given on the supposition that the plant was identical with *Holigarna racemosa*, Roxb., which is *Drimycarpus racemosus*, Hook. f., a pentamerous species from Bengal. The species was again described in Hook. Journ. Bot. ii. 39 (1850) and Hook. Ic. t. 842; also in Dalz. & Gibs. Bombay Flora, 51 (1861) and from the specimens in the Madras Herbarium and the description, the plant has oblong leaves 6-8 in. long, $1\frac{1}{2}$ to 3 in. broad, with an abrupt acumination, $\frac{3}{4}$ in. petiole and about 20 pairs of main-nerves. The flowers are in more slender open panicles up to 3 in. long and the drupe is transversely oblong, depressed at the apex and with a quite thin pericarp. In my opinion, Dalzell's plant, of which there is a considerable amount of material from the Bombay and Madras forests of the Western Ghâts, is distinct from *N. Colebrookiana*, under which it has been placed by Hooker and Engler, and I propose to change its name to *N. Dalzellii*, the specific name *racemosa* being apparently inadmissible.

In his Flora Sylvatica of South India and Ceylon, Beddome gives Blume's description of *Nothopegia* (amplified to describe the flowers, etc.) and a Plate, No. 164, drawn by Dr. Thwaites from a Ceylon specimen. Beddome's description and plate are also quoted by Hooker and Engler under *N. Colebrookiana*. An examination of the plate, of Beddomé's South Indian specimens and of Thwaites' C.P. 1260, shows that the plant figured has oblong, long—but not always abruptly—acuminate thin leaves, 3 to 5 in. long by 1 to $1\frac{1}{2}$ in. broad, very slender flower panicles and a transversely oblong vertically more or less striate drupe with thin pericarp. It is quite unlike Wight's plant and is distinct, in my opinion, from it. It differs less, perhaps, from *N. Dalzellii*, but the thin narrow leaves, nearly glabrous inflorescence, and striate fruit separate it, and I propose to call it *N. Beddomei*.

In the Flora of British India, a second variety of *N. Colebrookiana* was formed by Sir Joseph Hooker, based on Wall. Cat. 8500 and called var. *Heyneana*. It is a plant with small narrow obtuse leaves and blue drupe, and the Madras Herbarium contains a large number of specimens which are identifiable with Wall. Cat. 8500, their leaves varying in length from $1\frac{1}{2}$ to 5 in. and in breadth from $\frac{1}{2}$ to 2 in., their inflorescence very short and the fruit (immature only) ovoid apiculate. This can be, I think, quite safely regarded as a species, *N. Heyneana*.

There are two other species about which there is no question, *N. travancorica*, Bedd., and *N. aureo-fulva*, Bedd., the latter remarkable for having leaves subopposite, and the branchlets and petioles densely rusty-villous.

I think the arrangement arrived at, of 6 species, is the best I can propose, but I should not be at all surprised if *N. Dalzellii* were, after further investigation in the field, to be split up into two, a northern one with large prominently nerved leaves, the plant described by Dalzell, and a southern one chiefly represented in the Kew and Madras Herbaria by specimens collected by Lady Bourne, in which the leaves are smaller and much less prominently nerved and the inflorescence shorter. I have for the present called it var. *angustifolia*.

Connaraceae.

Rourea. I have not followed O. Kuntze and Schellenberg in separating the non-American species of *Rourea* as a separate genus *Santalodes* or *Santaloides*. The material available of *Rourea santaloides*, W. & A., seems to be roughly divisible into two groups, connected, however, by intermediates. One group has rather small, thick leaves, drying black; the other has larger and thinner leaves drying olive-brown. I have failed to find any good differentiating character in the flowers and fruits and must therefore follow previous workers and consider that there is only one rather variable species. The Flora of British India says the sepals are 'not ciliate' but in every case I have found them ciliate.

Connarus. I believe I am right in identifying Beddome's Vizagapatam specimen with *C. paniculatus*, Roxb.

XXVII.—TEFF RUST.

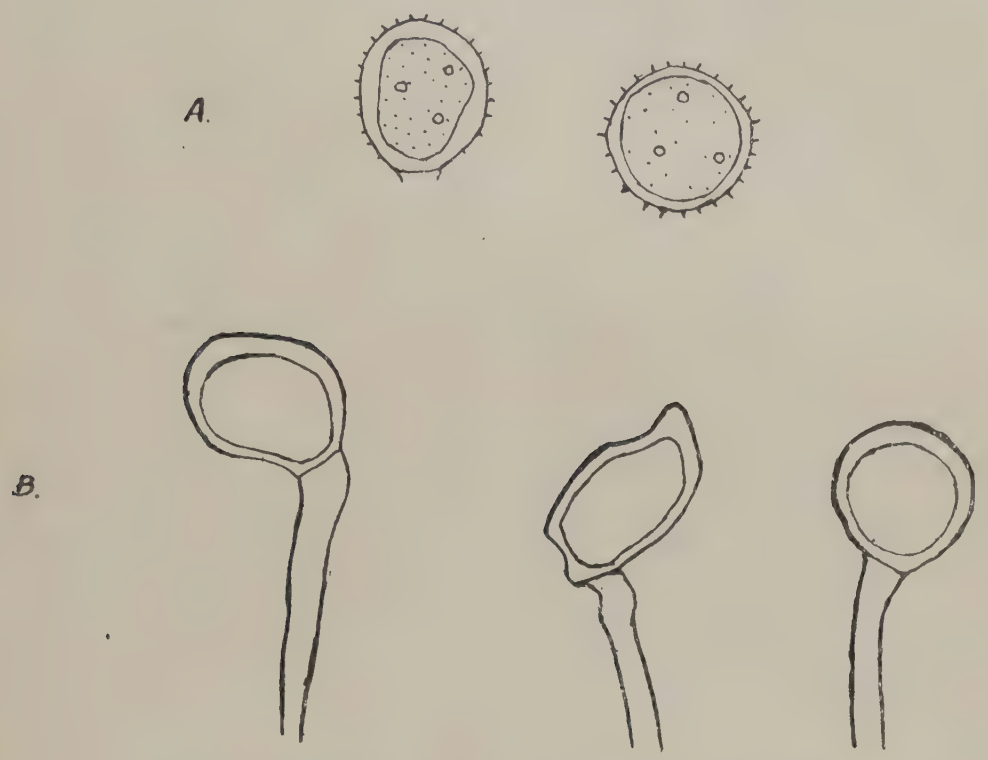
I. B. Pole Evans.

Teff (*Eragrostis abyssinica*, Link) in South Africa is very subject to rust, especially the crops which are grown late in the season. Rust has been observed on this crop for the past eight years, and is equally prevalent and destructive on both the High veld and Low veld. Heavy dews in particular hasten its appearance, and are most favourable to its development.

The rust belongs to the genus *Uromyces*, and appears to be an undescribed species. A somewhat similar rust, *Uromyces Eragrostidis*, Tracy, has been described on two species of *Eragrostis*, viz.: *Eragrostis pectinacea* from North America and *E. cynosuroides* from India. *E. curvula*, Nees, in South Africa is also commonly attacked by a rust, a species of *Uromyces* which differs slightly from the description of *U. Eragrostidis*, Tracy, chiefly in the length and colour of the teleutospore pedicel. The *Uromyces* on *Eragrostis curvula* is identical with that on Teff (*E. abyssinica*, Link), and it seems therefore not improbable that the rust which attacks Teff so severely in South Africa has passed over to it from the indigenous grass *E. curvula*.

The description of this rust is as follows:—

Uromyces pedicellata, *Pole Evans*. *Sori uredosporiferi* amphigeni, praecipue epiphylli, sparsi, oblongi, minuti, $\frac{1}{2}$-1 mm. longi vel confluendo striiformes majoresque, epidermide diutius tecti, flavo-brunnei; *uredosporae* globosae vel subglobosae, subtiliter echinulatae, flavae, 23-27 μ diametro, poris germinationis



A. Uredospores. B. Teleutospores. × 600.

5-7 instructae. *Sori teleutosporiferi* amphigeni vel culmicolae, minuti, oblongi vel lineares, epidermide diu tecti, atri; *teleutosporae* variabiles, globosae, subglobosae, piriformes, vel ellipsoideae, saepe angulatae, apice rotundatae vel truncatae, non vel lenissime incrassatae, leves, castaneo-brunneae, 15-22 × 21-30 μ: pedicellus hyalinus, apice leviter brunneolus, persistens, usque 45 μ longus.

South Africa. Transvaal: Pretoria, on leaves and stems of *Eragrostis abyssinica*, Link, and *E. curvula*, Nees, *Pole Evans*, 8945 (1915), 11318 and 11319 (1918).

XXVIII.—NEW AND RARE BRITISH FUNGI.

E. M. Wakefield.

During the past two years a number of miscellaneous fungi new to the British Flora have been noted in the course of official work.

The fungus *Cercosporella Antirrhini*, apparently an undescribed species, has been twice reported as doing some damage to cultivated Antirrhinums. *Nectria fusco-purpurea* occurred on plum trees of the variety Pond's Seedling which had died,

but there seems to be no evidence that this fungus was the cause of death. It was not, however, observed on other varieties of plum. The saprophyte *Merulius pinastri* frequently occurs in greenhouses and hothouses, and thrives so well in the moist, warm atmosphere as to become sometimes quite a pest. *Helminthosporium Warpuriae* appears to belong to the class of facultative parasites. It had gained entrance to the plant through a wound, and was growing further parasitically, but probably it is as a rule a saprophyte, and would not attack an uninjured plant.

The four following species are additions to the Flora of the Royal Gardens, Kew:—*Lepiota nauseosa*, Wakef., *Merulius pinastri* (Fr.) Burt, *Mastigosporium album*, Riess, var. *muticum*, Sacc., and *Helminthosporium Warpuriae*, Wakef.

The colour terms used are those of Ridgway's "Color Standards and Color Nomenclature."

Lepiota nauseosa, *Wakef.* sp. nov.

Pileus expansus, subumbonatus, carneo-ochraceus, circa 12 cm. diametro, adpresso-tomentosus, umbonem versus carneo-fulvus, areolato-rimosus; caro pilei crassa, albida, fracta vix flavescens. *Lamellae* latae, subdistantes, liberae, utrinque angustatae, e cremeo leviter roseo-tinctae. *Stipes* 16 cm. longus, 8-9 mm. diametro, pileo concolor sed tactu fulvescens, fibrillis paucis brunneis ornatus, sursum incrassatus, pallidus, deorsum vix bulbosus, albidus, intus solidus; caro stipitis albida fracta praesertim infra flavescens. *Annulus* superus, araneosus, fugax. *Sporae* hyalinae, globosae, basi apiculatae, 6·5-8 μ. *Odor* nauseosus.

On soil in Nepenthes House, Kew, Feb. 1918.

This fine species in general characters is near to the larger species of *Lepiota*, but it is remarkable for the delicate, cortinate annulus, in which respect it agrees with the genus *Cortinellus* of Roze. *L. Cortinarius*, Lange, has a similar veil, but is much smaller, and has different spores. The ground colour of the pileus is "light ochraceous buff" of Ridgway's system, whilst the tomentose scales about the disk are from fawn to hazel. The annulus is coloured like the pileus, but paler, and the fibrils on the stem are hazel. The whole fungus has a heavy, sickening odour.

Merulius pinastri, *Burt* in Ann. Miss. Bot. Gard. iv., 1917, p. 356.

Hydnum pinastri, Fr. Obs. Myc. I, p. 149.

A *Merulius* which is apparently this species occurred in abundance in the Tropical Pits at Kew in September, 1917, growing over benches, flower-pots, the cedar chips in which the pots are imbedded, and on an old piece of sacking. The Kew material, however, shows some features which are not mentioned in the description given by Burt. His description of the fructifications as "pinard yellow at first, then olive-ocher, the margin whitish," and of the spores as "pale ochraceous" applies only to small, young specimens, but even

in these there is frequently a tinge of pale flesh-pink in the marginal mycelium. In older specimens, which may extend for about 8 in. when growing under suitable conditions, as on the under side of a bench, the reddish colour of the mycelium is often quite pronounced, and may be best described as deep brownish vinaceous. It is due to a reddish colouring matter which is excreted from the hyphae, and is seen adhering to them in the form of small drops. The spores of old specimens are also more deeply coloured (fulvous), so that the hymenium eventually becomes from Dresden brown to raw umber. When dry the fructification is exceedingly thin and paper-like, with a rather broad, cobwebby margin.

Hymenium for a long time smooth, at length raised in shallow folds which form irregular, angular pores or reticulations, 0·5-1·5 mm. in diameter, or when growing on an upright surface may be prolonged as short teeth. Hyphae hyaline, 2-4 μ in diameter. Spores yellow-brown, elliptical, smooth, 5-7 $\times$ 4 μ (average 6 $\times$ 4 μ).

Lysurus borealis, (*Burt*) *P. Henn.* in Hedwigia xli, 1902, p. 173.

Typical specimens of this plant, agreeing exactly with Burt's description and figures of the American species, appeared on a heap of stable refuse in Chiswick, at intervals from September until the end of November, 1916, and again in the same place in September, 1917. It is characterised by having the arms of the receptacle beneath the gleba of a beautiful pale reddish colour, which is reproduced exactly in the coloured figure given by Murrill in Mycologia iv., Pl. LXVIII.

There have been two previous records of species of *Lysurus* in this country. The first was found at Kidderminster, and referred by Rea to *L. australiensis*, Cke. & Mass.* His figure represents it as having arms of a yellowish-brown, but he describes the colour as reddish-brown. Another specimen found at Manchester by Mr. H. Murray had red arms, and was named by Lloyd *L. borealis*.† If the descriptions of *L. australiensis* and *L. borealis* be compared, it is obvious that the plants are very close, and the question arises whether the names be synonymous. The chief difficulty is due to this question of the colour of the receptacle.

The original description of *L. australiensis* gives "receptaculo fusco," but as it was probably drawn up from dried material, little weight can be attached to this statement. Later descriptions, also, for the most part, say little about the colour of the plant. An enquiry as to this point was therefore sent to Dr. J. B. Cleland, of Sydney, who is working out the Basidiomycetes of New South Wales. Dr. Cleland states in reply that the Australian plant is usually entirely white, but that he has seen one large specimen (4 in. high and 1 in. thick), in which the arms were orange, the upper part of the stem paler orange, and the base whitish. There is also in the Kew Herbarium a

* Trans. Brit. Myc. Soc. ii, 1903, p. 57.

† Lloyd, Syn. Phall. 1909, p. 40.

pencil sketch of a *Lysurus* by the late F. M. Bailey, on which he noted that the arms had a "rose-coloured border."

It seems, therefore, that *L. australiensis*, though typically entirely white except for the gleba, may occasionally vary in the direction of developing some colour in the arms of the receptacle.

On the other hand, the American and European plant has usually distinctly reddish arms. An entirely white form, however, has been recorded from Mecklenburg, Germany, and named by Hennings *L. borealis*, var. *Klitzingii*.* In this connection it may also be noted that when eggs of the Chiswick plant were allowed to develop indoors, the red colour was absent, suggesting that it is dependent on the presence of sufficient light.

Difference of illumination, however, will not account for the fact that the Australian *Lysurus* is normally entirely white, while the plant of the northern hemisphere has normally red arms. If they be regarded as two distinct species, Hennings' var. *Klitzingii* should be referred to as a synonym of *L. australiensis*. But except for this colour difference, the plants appear to be indistinguishable, and it seems more probable that they represent geographical forms of one species. In view of the fact that the difference is fairly constant, it is nevertheless desirable to keep the distinctive name *borealis* for the red Northern form.

The further suggestion, made by both Lloyd † and Cleland,‡ that *L. borealis* and *L. australiensis* are identical with *L. Gardneri*, Berk., of Ceylon, does not appear to be justified. According to Petch § the arms of *L. Gardneri* (referred by him to *Colus*) are always united at the apex, a condition which is only exceptional in *L. australiensis*. Furthermore, the gleba in *L. Gardneri* does not as a rule extend to the base of the arms, whereas it always does so in *L. borealis* and *L. australiensis*. No red form of *L. Gardneri* has ever been recorded.

Nectria fusco-purpurea, *Wakef.*, sp. nov.

Stromata dilute lateritia, ceracea, applanata, 4-8 mm. longa, 1-2 mm. lata, per rimas transversas corticis erumpentia, primo conidia gerentia. *Conidia* cylindrica, utrinque obtusa, vix curvula, 8-11 × 2-2·5 μ. *Conidiophora* simplicia vel ramosa, hyalina, 1·5-2 μ diametro. *Perithecia* dense constipata, compressione laterali deformia, stroma obscurata, sessilia, fusco-purpurea, carnosula, contextu parenchymatico rubro, sicco collapsa, pezizoidea, rugulosa, 0·25 mm. diametro, ostiolo minuto pertusa. *Asci* cylindracei, octospori, 80-90 × 10-12 μ. *Paraphyses* filiformes, ramosae, hyalinae, 1·5 μ diametro. *Sporae* monostichae vel subdistichae, variabiles, oblongae, utrinque obtusae, medio 1-septatae, interdum 2-3-septatae, ad septa constrictae, 14-33 × 4·5-8·5 μ.

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* Hedwigia xli., 1902, p. 173.

† Lloyd in Myc. Notes, No. 28, p. 370. Lloyd corrected this opinion in his Syn. Phall., but reverted to it in Myc. Notes No. 41, p. 571.

‡ Cleland and Cheel in Journ. and Proc. Roy. Soc. New South Wales, xlix, 1915, p. 204.

§ Ann. Roy. Bot. Gard. Peradeniya, iv., p. 174.

On dead branches of plum (Pond's Seedling), Wisbech, coll. *J. C. F. Fryer*, 1917; *A. D. Cotton*, 1917.

While most of the spores have only one septum, occasional large spores with two or three septa are present, suggesting relationship with the genus *Calonectria*. Frequently one or more cells of these larger spores are much swollen, as in Saccardo's figures of abnormal spores of *Calonectria varians*.

The transversely elongated stromata give the species a habit markedly different from that of the other British Nectrias. The conidial stage is bright pink, but the stroma is eventually almost completely hidden by the crowded perithecia which are dark brownish-purple to the naked eye, but whose walls are red by transmitted light.

Cercosporella Antirrhini, *Wakef.*, sp. nov.

Maculae orbiculares, depressae, ex atro-viridi pallidae, arescentes, 2-4 mm. diametro. *Acervuli* epiphylli, sparsi, minuti, albidi vel demum conglutinati, subhyalini, dilute roseo-tincti. *Conidiophora* dense constipata, hyalina, ramosa, 2-4 μ diametro. *Conidia* hyalina, elongato-obclavata, curvula, 25-48 × 2·25-3·5 μ, ad 3-septata.

Hab. On living leaves and stems of garden Antirrhinums, Worcester, Sept., 1917; also Birmingham, June, 1918, *W. B. Grove*.

The fungus attacks the still living, vigorous leaves and stem, forming small sunken patches having a darker green waterlogged appearance. Under the lens the minute sori are seen scattered all over the patch, whitish and pulverulent at first, but in the presence of abundant moisture becoming agglutinated and pale rose-coloured. Later the spots dry out from the centre, becoming pale alutaceous and thereby more definite and conspicuous.

Mastigosporium album, var. **muticum,** *Sacc.* Ann. Myc., 1911, p. 254.

Distinguished from the type form by the conidia having no cilia and being slightly smaller. Conidiophores 13-15 × 3-5 μ. Conidia 32-38 × 10-12 μ, oblong-elliptical, rounded at both ends, 3-septate.

On leaves of *Dactylis glomerata*, Kew, 1918, and Oxshott, Oct., 1917.

Helminthosporium Warpuriae, *Wakef.*, sp. nov.

Mycelium atro-olivaceum, lanosum, effusum. *Conidiophora* rigida, erecta, umbrina, apice rotundata vix dilatata, 300-500 × 6-8 μ. *Conidia* solitaria, obclavata, apice obtusa, pallide grisea, crasse tunicata, 8-11-septata, 115-190 × 12-14 μ.

On an injured stem of *Warpuria clandestina*, Stapf, Tropical Pits, Kew, July, 1917.

XXIX.—NEW ORCHIDS: DECADE XLVI.

451. **Pleurothallis** (§ **Macrophyllae Racemosae**) **grandis,** *Rolfe*; affinis *P. lamellariis*, Lindl., sed scapis longioribus erectis et floribus duplo majoribus facile distinguenda.

Herba epiphytica, circiter 50 cm. alta. *Caules* elongati, cylindrici, 30-40 cm. longi, vaginis paucis tubulosis carinatis 7-9 cm. longis obtecti. *Folia* sessilia, subcordata-ovata, subobtusa, coriacea, 17-22 cm. longa, 9-17 cm. lata. *Spatha* lanceolata-oblonga, acuta, conduplicata, 3 cm. longa. *Scapi* erecti, 45 cm. longi; racemi multiflora. *Bracteae* ovatae, subacutae vel apiculatae, conduplicato-concavae, circiter 1 cm. longae. *Pedicelli* arcuati, verruculosi, 1·5 cm. longi. *Flores* secundi, patentes, pro genere magni, brunneo-suffusi. *Sepalum* posticum suberectum, lineari-lanceolatum, subobtusum, 2·8 cm. longum, basi subconcavum, margine revolutum; *sepala* lateralia alte connata, oblonga, subconcava, 3 cm. longa, 1·2 cm. lata, apice biloba, lobis subobtusis. *Petala* parallela, oblonga, obtusa, coriacea, 1 cm. longa, supra medium valde incurva. *Labellum* ovato-oblongum, obtusum, ·2 cm. longum, basi dilatatum, ad latera involutum et verruculosum, apice abrupte incurvum; discus carnosus. *Columna* clavata, 5 mm. longa.

Central America. Costa Rica; near Cachi, *C. H. Lankester*, 3.

A large and very distinct species which flowered at Kew in September, 1917, and in August, 1918. The flowers are borne in a one-sided raceme, the ground colour being green, more or less suffused and striped on the sepals with brownish red.

452. **Bulbophyllum robustum,** *Rolfe* in Bot. Mag. sub. t. 8000, sine descriptione; affine *B. crenulato*, Rolfe, sed habitu robustiore, sepalis lateralibus angustioribus et ovarii carinis integris differt.

Rhizoma repens, validum, vaginis ovatis ancipitibus acutis imbricatis obtecta. *Pseudobulbi* tetragoni, acutanguli, oblongi vel ovoideo-oblongi, 4-6 cm. longi, 1·5-2 cm. lati, diphylli. *Folia* elliptico-oblonga, subobtusa, coriacea, 12-22 cm. longa, 2-3 cm. lata. *Scapi* suberecti, 15-25 cm. longi, vaginis tubuloso-spathaceis obtecti; spica patens vel recurva, oblonga, crassa, densiflora, 6-8 cm. longa, circiter 1·5 cm. lata, rachi alveolata. *Bracteae* late ovatae, subobtusae, 3 mm. longae. *Pedicelli* crassissimi, 3 mm. longi. *Flores* parvi, carnosi, 4-5 mm. longi. *Sepalum* posticum inflexum, ellipticum, obtusum; *sepala* lateralia connata; limbus late ovatus, obtusus, papillosus, margine crenulatus. *Petala* triangulari-linearia, obtusa, hyalina, 1·5 mm. longa. *Labellum* orbiculare, emarginatum, crassum, 2·5 mm. latum, basi subcordatum. *Columna* brevissima; alae subulato-oblongae, subacutae, 0·5 longae.

Madagascar. Central district; without exact locality, *Rev. R. Baron*, 2324, 2723.

A plant of this species, received from the Royal Botanic Gardens, Glasnevin, 1914, without a name, flowered in the Kew collection in May, 1917. The sepals are green, with many more

or less confluent brown spots; the petals, hyaline with a purple stripe; the lip is dull green, and sunk in a cavity formed by the united lateral sepals.

453. **Maxillaria parviloba,** *Rolfe*; affinis *M. leucaimaitae* Rodr., sed foliis angustioribus, sepalis petalisque longioribus, et labello breviore differt.

Herba epiphytica. *Pseudobulbi* aggregati, oblongi, subcompressi, 5 cm. longi, 2 cm. lati, diphylli. *Folia* subpetiolata, lorata, subacuta, circiter 35 cm. longa, 3 cm. lata, basi angustata. *Scapi* suberecti, 9-12 cm. longi, vaginis spathaceis lanceolato-oblongis obtecti. *Bracteae* spathaceae, lanceolato-oblongae, subobtusae, 3 cm. longae, 3 cm. latae. *Flores* mediocres. *Sepalum* posticum lanceolato-oblongum, acutum, subconcavum, 4 cm. longum; *sepala* lateralia subpatentia, 4 cm. longa, basi in mentum brevissimum obtusum extensa. *Petala* subfalcata, lineari-oblonga, acuminata, 2·5 cm. longa. *Labellum* circiter 1·3 cm. longum, breviter trilobum; lobi laterales falcato-oblongi, obtusi, 2·5 mm. lati; lobus medius ovato-oblongus, obtusus, crassus, 3·5 mm. longus, margine recurvus, facie papillosus; callus oblongus, obtusus, crassus. *Columna* clavato-oblonga, 1 cm. longa.

Habitat believed to be Peru.

Flowered in the establishment of Messrs. Sanders, St. Albans, in May, 1917. The flowers are light yellow, with a faint pink suffusion in the sepals and petals; lip white, suffused with brownish pink on the side lobes, and the front lobe dusky brown on the face, red-purple behind, and with a narrow yellow margin; apex of crest yellow.

454. **Chrysocycnis Lehmanii,** *Rolfe*; affinis *C. Schlimii*, Lind. et Reichb. f.; labello elliptico-oblongo basi late auriculato nec ovato et anguste sagittato differt.

Herba epiphytica. *Caulis* scandens, validus, 0·5-0·7 cm. latus, vaginis ovatis subimbricatis obtectus; internodii 6·15 cm. longi. *Pseudobulbi* oblongi, subcompressi, 2·3 cm. longi, 0·5-0·7 cm. lati, monophylli. *Folia* breviter petiolata, ovato-elliptica vel subcordato-elliptica, obtusa, coriacea, 8-14 cm. longa, 4-8 cm. lata; petiolus circiter 1 cm. longus. *Scapi* axillares, 4-5 cm. longi, vaginis ovato-lanceolatis acutis obtecti, uniflori. *Bracteae* spathulatae, ovato-lanceolatae, acuminatae, 2 cm. longae. *Flores* ampli, ochracei vel pallide rosei. *Sepalum* posticum lanceolato-oblongum, acutum, incurvum, 2·5 cm. longum; *sepala* lateralia patentia, ovato-oblonga, acuta, 2·5 cm. longa. *Petala* falcato-oblonga, obtusa, subreflexa, 2 cm. longa. *Labellum* hastatum, 1 cm. longum; lobus intermedius elliptico-oblongus, obtusus, subconcavus, leviter carinatus; lobi laterales late auriculati, 3 mm. lati. *Columna* clavata, incurva, 1·3 cm. longa, alis brevissimis latis.

Ecuador. Banos; on the Tunguaragua Volcano, 1600-2300 m., *Lehmann*, 8252.

Lehmann's drawing shows the flowers ochraceous or with a

faint shade of pink, and the column light green with a few minute transverse light brown spots.

455. **Listrostachys floribunda,** *Rolfe*; a *L. muscicola*, Rolfe, foliis longioribus subrecurvis et bracteis duplo minoribus facile distinguenda.

Herba epiphytica, nana, subacaulescens. *Folia* disticha, approximata, lineari-oblonga, subrecurva, oblique et brevissime bidentata, subcoriacea, 9-13 cm. longa, 1-1·2 cm. lata, lobis obtusis. *Scapi* suberecti, graciles, 8-12 cm. longi, 6-8-flori. *Bracteae* ovato-oblongae, subobtusae, conduplicato-concavae, submembranaceae, 4-5 mm. longae. *Pedicelli* graciles, circiter 2 cm. longae. *Flores* mediocres, albi. *Sepala* patentia, apice recurva; posticum elliptico-lanceolatum, acutum, 0·8 cm. longum; lateralia oblongo-lanceolata, acuta, 0·9 cm. longa. *Petala* recurva, lineari-oblonga, acuta, 0·7 cm. longa. *Labellum* deltoideo-ovatum, acutum, 0·8 cm. longum, apice recurvum, prope basin leviter constrictum; calcar 6 cm. longum, gracillimum, curvatum. *Columna* lata, 4 mm. longa; pollinia globosa; stipites gracillimi, 1·5 mm. longi; glandula squamata.

Tropical Africa. Uganda; at Umpala.

Received from the Department of Agriculture, Uganda, in 1916, and flowered at Kew in September, 1917. The flowers are white, tinged with buff on the elongated slender spurs.

456. **Vanilla Havilandii,** *Rolfe*; a *V. albida*, Bl., racemis longioribus, bracteis numerosis subaggregatis differt.

Herba scandens. *Folia* petiolata, anguste elliptica vel elliptico-lanceolata, acuminata, subcoriacea, 10-17 cm. longa, 2·5-5 cm. lata; petiolus circiter 1 cm. longus. *Racemi* axillares, 3-4 cm. longi, multiflori *Bracteae* numerosae, subaggregatae, suborbiculares vel ovato-oblongae, obtusae, concavae, 3-4 mm. longae. *Pedicelli* 4-5 cm. longi. *Flores* circiter 3 cm. longi. *Sepala* elliptico-oblonga, obtusa, 3 cm. longa. *Petala* oblanceolato-elliptica, obtusa, 3 cm. longa, basi subattenuata. *Labellum* circiter 3 cm. longum, tubo brevi; limbus dilatatus, subintegre late rotundatus, repando-lobulatus, crenulatus, infra apicem lineis incrassatis et integris notatus; crista oblonga, lamellis fimbriatis subdensis composita. *Columna* circiter 2 cm. longa, alis angustis. *Fructus* subcylindricus, 11-15 cm. longus.—*V. albida*, Ridl. in Journ. Linn. Soc. xxxi. p. 303; Rolfe, l.c. xxxii. p. 459: non Bl.

Borneo. Kuching, *Dr. Haviland.* Sarawak; Matang, at edge of the tea estate; "flowers green; lip white, larger than petals, with the central bar elevated," *H. N. Ridley.*

Hitherto referred, somewhat doubtfully, to the Javan *V. albida*, Bl., though when monographing the genus I called attention to the more numerous bracts of Dr. Haviland's fruiting specimen, the only one seen. A specimen subsequently collected by Mr. Ridley has quite identical bracts, and as there are both flowers and fruits, it appears to represent a distinct but allied species. Unfortunately the only specimen of the Javan plant at

Kew is without flowers and fruit, so that comparison has had to be made with drawings of these organs.

457. **Vanilla andamanica,** *Rolfe*; a *V. albida,* Bl., foliis angustioribus, floribus majoribus et labelli disco prope apicem verrucoso differt.

Herba scandens. *Folia* petiolata, oblongo-lanceolata, acuminata, subcoriacea, 14-19 cm. longa, 2·5-4 cm. lata; petiolus 1-1·5 cm. longus. *Racemi* axillares, 2-3 cm. longi, multiflori. *Bracteae* ovato-oblongae, obtusae vel subacutae, 4-5 mm. longae. *Pedicelli* circiter 2 cm. longi. *Flores* circiter 5 cm. longi. *Sepala* oblongo-lanceolata, subobtusa, circiter 5 cm. longa. *Petala* oblanceolato-elliptica, obtusa, basi subattenuata, circiter 5 cm. longa. *Labellum* 5 cm. longum; tubo basi angusto; limbus subinteger, ovato-rotundatus, repando-lobulatus, crenulatus, infra apicem lineis vel venis verruculosis instructus; crista obovoideo-oblonga, e lamellis densis fimbriatis composita. *Columna* 3·5 cm. longa, alis rotundatis.

Tropical Asia. Andaman Islands; at Betapur Valley, *C. E. Parkinson,* 1139.

Sent for determination from the Forest Research Institute and College, Dehra Dun. It has much the general appearance of the Javan *Vanilla albida,* Bl., but the flowers are considerably larger, and the tube of the lip longer and much narrowed at the base, while the crest is denser, and the three central nerves of the lip are thickened and verrucose near the apex. A fruiting specimen has not been seen.

458. **Peristylus ugandensis,** *Rolfe*; a *P. Petitiano,* A. Rich., floribus minoribus, labello breviter trilobo, non tripartito, differt.

Herba terrestris, foliosa, 35-45 cm. alta. *Folia* sessilia, elliptica vel ovato-elliptica, subacuta, 7-nervia, 3-7 cm. longa, 1·5-3 cm. lata. *Spicae* 5-12 cm. longae, angustae, densae, multiflorae. *Bracteae* ovato-lanceolatae, acutae vel acuminatae, 0·5-1 cm. longae. *Flores* parvi, flavo-virides. *Sepala* subconniventia, elliptico-ovata, subobtusa, 2·5-3 mm. longa. *Petala* elliptico-ovata, subobtusa, 2-2·5 mm. longa. *Labellum* late oblongum, breviter trilobum, carnosulum, 3 mm. longum; lobi oblongi, circiter 1 mm. longi; discus carinatus; calcar late oblongum, vix 1 mm. longum. *Columna* lata, vix 1 mm. longa.

Tropical Africa. Uganda; bushy highlands at Lamaru, 3000 m., *Scheffler,* 244.

459. **Peristylus Snowdenii,** *Rolfe*; a *P. ugandensi,* Rolfe, floribus majoribus, labello latiore et calcare saccato-globoso differt.

Herba terrestris, foliosa, 35-45 cm. alta. *Folia* sessilia, ovata, subacuta, undulata, 7-nervia, 3-5 cm. longa, 2·5-3 cm. longa. *Spicae* 10-12 cm. longae, angustae, densae, multiflorae. *Bracteae* ovato-lanceolatae, acuminatae, 0·6-1·2 cm. longae. *Flores* parvi, flavo-virides. *Sepala* late oblonga, obtusissima, 3-3·5 cm. longa.

Petala late oblonga, obtusissima, 2·5-3 cm. longa. *Labellum* subquadratum, trilobum carnosulum, 3 mm. longum; lobi oblongi, subobtusi, 1 mm. longi; discri laeves; calcare saccato-globosum, 1 mm. longum. *Columna* lata, vix 1 mm. longa.

Tropical Africa. British East Africa; short grass land at Limuru, 2250 m., "flowers greenish yellow with brown rostellum," *J. D. Snowden*, 554.

460. **Habenaria Hunteri,** *Rolfe*; inter species africanas floribus magnis, labello amplo trilobo, lobis lateralibus amplissimis fimbriatis, et lobo intermedio lineari facile distinguenda.

Caules validi, 30 cm. longi, foliosi. *Folia* sessilia, lanceolato-oblonga vel elliptico-oblonga, acuta vel acuminata, undulata, subrecurva, 7-20 cm. longa, 3-4 cm. lata, superne decrescentia. *Racemus* subsessilis, triflorus. *Bracteae* ovatae, acuminatae, 2·5-3 cm. longae. *Pedicelli* 4-4·5 cm. longi. *Flores* magni, albi. *Sepalum* posticum erectum, ovatum, subobtusum, concavum, 1-8 cm. longum, 1 cm. latum; *sepala* lateralia patentia, oblique ovata, subobtusa, 2 cm. longa, 1 cm. lata. *Petala* integra, oblongo-lanceolata, acuta, 1·5 cm. longa, cum sepalo postico in galeam conniventia. *Labellum* breviter unguiculatum; unguis patens; limbus trilobus, late flabellatus, 3·5 cm. latus; lobus intermedius oblongus, obtusus, 1·5 cm. longus; lobi laterales patentes, oblique obovato-flabellati, inciso-fimbriati, 1·5 cm. longi, 2·2 cm. lati; calcar cylindricum, spiraliter curvatum, 13-15 cm. longum. *Columna* 0·7 longa; pollinia clavata, 3 mm. longa; caudiculi gracillimi, 0·8 cm. longi, curvati. *Stigmata* subparallela, late clavato-oblonga, subcurvata, 5 mm. longa; rostellum trilobum; lobus intermedius triangulari-ovatus, obtusus, 5 mm. longus; lobi laterales curvati, 5 mm. longi.

Tropical Africa. Gold Coast; without precise locality, *T. Hunter*.

A striking species, in habit not unlike *H. leonensis*, Kränzl., but the large flowers bear a strong general resemblance to those of *H. Susannae*, R. Br. Their colour is white, with green stigmas. The tubers were received from Mr. T. Hunter, Senior Curator of the Gold Coast Botanical Department, in 1915, and the plants flowered in the Kew collection in August, 1917.

XXX.—DECADES KEWENSES

Plantarum Novarum in Herbario Horti Regii Conservatarum.

DECAS XCI.

901. **Pygeum sisparense,** *Gamble* [Rosaceae-Pruneae]; species *P. acuminato*, Colebr., affinis, foliis minoribus et racemis brevioribus, etiam staminibus paucioribus differt.

Arbor parva, ramulis siccitate fere nigris rugosis. *Folia* lanceolata, apice acuta, basi in petiolum attenuata, marginibus recurvis prope basin glandulis 2 parvis aliquando munita, 5-10 cm. longa, 2-4 cm. lata; nervi utrinque circiter 8, obliqui;

petiolus 1·5 cm. longus. *Racemi* axillares, 4-5 cm. longi, crispato-puberuli; pedicelli 2 mm. longi; flores parvi, bracteolis minutis suffulti. *Calycis tubus* late campanulatus, lobis 5 ovatis minutis pubescentibus. *Petala* 5, oblonga, pubescentia, calycis lobis fere duplo longiora. *Stamina* circiter 20, filamentis gracilibus incurvis alternatim longis et brevibus. *Ovarium* glabrum, stylo perbreve. *Drupa* transverse oblonga, glabra, violacea, circiter 1·5 cm. longa, 2 cm. lata.

South India. In forests on the South West side of the Nilgiri plateau, about Sispara, at 1920-2250 m., *Gamble*, 14339, 14472, 20582, 20637 (collected in 1884 and 1889).

902. **Eugenia discifera,** *Gamble* [Myrtaceae-Myrteae]; *E. calcadensi*, Bedd., affinis, pedicellis brevioribus epedunculatis, e ramulis infra folia ortis, foliis subtus siccitate griseis differt.

Arbor parva, ramulis teretibus pallidis, ultimis sicut inflorescentia molliter ferrugineo-pubescentibus. *Folia* obovata, apice abrupte obtuse acuminata, basi acute attenuata, parce pubescentia, subtus grisea, 5-6 cm. longa, 2-3 cm. lata, nervis utrinque circiter 12-15 irregularibus haud conspicuis sub marginem arcuatim junctis; petiolus 5-10 mm. longus, laminae marginibus decurrentibus notatus. *Flores* parvi, bini e ramulis novis infra folia orti, epedunculati; pedicelli graciles, 5-7 mm. longi; bracteolae ad basin calycis 2, lanceolatae, 2 mm. longae. *Calycis* lobi rotundati, pubescentes, ciliati, 2·5 mm. longi. *Petala* orbicularia, pellucide punctata, fere glabra. *Discus* staminifer conspicuus, villosus, 3-5 mm. latus. *Fructus* ignotus.

South India. Evergreen forests of the Western Ghats in Travancore, near Chimunji, 1300 m., April, 1895, *T. F. Bourdillon*, 580, 787.

903. **Jambosa Bourdillonii,** *Gamble* [Myrtaceae-Myrteae]; *Eugeniae hemisphericae*, Wight, affinis, foliis subtus conspicue nervosis, cymis brevissimis calycis tubo campanulato differt.

Arbor mediocris, glaber, ramulis teretibus griseis. *Folia* chartacea, elliptico-oblanceolata, apice acuminata acumine obtuso, basi cuneata, 8-12 cm. longa, 3-4 cm. lata, nervis utrinque 8-10 fere rectis in nervum intramarginalem fere 3-5 mm. e margine distantem junctis supra obscuris infra conspicuis; petiolus brevis, crassus, circiter 3 mm. longus. *Cymae* terminales vel aliquando laterales, subsessiles, pauciflorae, vix 3 cm. longae; pedicelli 5 mm. longi, subtetragoni. *Calycis tubus* campanulatus, ad 1 cm. longus; lobi rotundati, 3 mm. longi, fructiferi recurvi. *Petala* 4, orbicularia, circiter 7 mm. diametro, conspicue sed sparse glanduloso-punctata. *Fructus* maturus nondum visus, immaturus hemisphericus, disco conspicue coronatus.

South India. In the evergreen forests of Travancore about Merchiston, at 660 m., April, 1895, *T. F. Bourdillon*, 596, 859.

904. **Jambosa courtallensis,** *Gamble* [Myrtaceae-Myrteae]; species distincta, quoad foliorum nervationem *Eugeniae Mundagam*, Bourdillon, affinis, sed foliis multo minoribus basi rotundatis nec cordatis, calycis tubo elongato subcylindrico differt.

Arbor ramulis superne pallide brunneis subtetragonis. *Folia* opposita coriacea, elliptica, obtusa vel obtuse acuta, ad basin rotundata vel paullo attenuata, glabra, 7-13 cm. longa, 4-6·5 cm. lata, nervis utrinque circiter 8 distantibus curvatis et arcuatim junctis, nervulis alteris minoribus marginem versus adjunctis, reticulatione conspicua; petiolus brevissimus, 3-4 mm. longus, crassus. *Cymae* terminales, trichotomae; pedunculi 10-15 mm. longi, crassi; pedicelli plus minusve recurvati. *Calycis tubus* subcylindricus, superne paullo ampliatus, 12-15 mm. longus, fauce 7-8 mm. diametro, disco annulari munitus; lobi 4, ovati, quorum 2 margine subhyalino, 3-4 mm. longi, recurvi. *Petala* 4, orbicularia, patentia. *Stamina* numerosa, filamentis 10-15 mm. longis. *Ovarium* calycis tubi basin versus 2-locellatum, ovulis numerosis; stylus longus, stigmate minuto. *Fructus* ignotus.

South India. Courtallum, Tinnevelly hills, *Wight* (K. D. 1054). Ceylon. *J. Fraser*, 111.

905. **Syzygium palghatense,** *Gamble* [Myrtaceae-Myrteae]; *S. calophyllifolio*, Walp., affine, foliis obovatis abrupte obtuse acuminatis conspicue glandulosis, et calyce infundibuliformi elongato differt.

Arbor procera, ramulis brunneis ultimis subtetragonis. *Folia* coriacea, obovata, apice abrupte obtuse acuminata, basi cuneata fere sessilia, conspicue glanduloso-punctata, 3·6-4·5 cm. longa, 1-2 cm. lata, marginibus reflexis, nervis utrinque circiter 10-12 vix prominulis. *Cymae* terminales vel in axillis foliorum ultimorum, pauciflorae, ad 4 cm. longae, pedicellis subtetragonis. *Calycis* tubus elongatus, infundibuliformis, fere 1 cm. longus, lobis rotundatis 1 mm. longis. *Petala* calyptratim decidua. *Fructus* maturus ignotus.

South India. In the Palghat hills of Malabar, at 1625 m., *Beddome*, 254.

906. **Syzygium travancoricum,** *Gamble* [Myrtaceae-Myrteae]; nulli specierum aliarum peraffine, foliis longe petiolatis, cymis axillaribus longe pedunculatis et longe ramulosis floribus parvis insignis.

Arbor, ramulis tetragonis. *Folia* chartacea, ovata, apice obtusa acumine plicato, basi angustata in petiolum 1·5-2 cm. longum decurrentia, 8-10 cm. longa, 5-6 cm. lata, nervis utrinque 10-15 irregularibus distantibus, intra marginem arcuatim junctis sine nervo intramarginali conspicuo. *Cymae* axillares, ad 15 cm. longae, corymbosae; pedunculus communis 5-8 cm. longus, rami etiam longi; flores parvi. *Calycis tubus* brevis, vix 1 mm. diametro; lobi perbreves. *Petala* verosimiliter calyptratim decidua. *Fructus* ignotus.

South India. In swampy places in the low country of Travancore, up to 65 m., March, 1895, *T. F. Bourdillon*, 540.

From the specimen in Herb. Kew this seems to be the *Eugenia montana* of Bourdillon in "Forest Trees of Travancore," p. 186, but as Sir Dietrich Brandis has pointed out in a note attached to the specimen, it is quite distinct from *E. montana*, Wight, which is a tree of high level Sholas of the Nilgiris.

907. **Meteoromyrtus,** *Gamble*, gen. nov.; *Eugeniae*, Linn., affinis, differt praecipue ovulis ab apice ovarii loculorum pendulis circiter 4.

Arbor parva vel arbuscula. *Folia* opposita, membranacea, penninervia, juventute villosa. *Flores* parvi, pedicellis unifloris axillaribus vel supra-axillaribus villosis; bracteolae lineares 2 infra calycem et calyce longiores. *Calycis tubus* brevis ad faucem disco munitus, lobis 4 lanceolatis villosis corollae paullo longioribus. *Petala* 4, suborbicularia, pellucido-punctata. *Stamina* indefinita, annulo ad marginem disci inserta; antherae parvae, rimis longitudinalibus. *Ovarium* biloculare, ovulis circiter 4 in utroque loculo ab apice pendulis; stylus elongatus; stigma subcapitatum. *Fructus* maturus ignotus. *Species* unica.

M. wynaadensis, *Gamble*, comb. nov. *Eugenia wynaadensis*, Beddome in Madr. Lit. Soc. Journ. ex Ic. Pl. Ind. Or. 35, t. 161; Fl. Sylv. Anal. Gen. cx; Fl. Br. Ind. ii. 506.

South India. Common about Devala in the South-East Wynaad, at 650-960 m., *Beddome*.

Both Beddome in his Icones, and Duthie in the Fl. Brit. India have signalized this species as being probably the type of a new genus, and so I have no hestitation in describing it as such in spite of the poor material, in order to bring the plant into its proper place in the Madras Flora.

908. **Osbeckia lineolata,** *Gamble* [Melastomaceae-Osbeckieae]; *O. minori*, Triana, affinis, foliis majoribus ellipticis siccitate flavescentibus ad superficiem superiorem lineolis conspicuis apice setoso-mucronatis ornatis, floribus et fructibus majoribus differt.

Suffrutex erectus, lignosus, ramulis plus minusve angulatis glaucis ultimis flavescentibus quadrangularibus. *Folia* elliptica, siccitate flavescentia, apice acuta, basi acuta rotundata vel subcordata, 3-5 cm. longa, 1·5-2·5 cm. lata, et basi tricostata, addito nervorum intramarginalium pari inconspicuorum, nervis et nervulis transversis haud conspicuis in facie lineolis latis conspicuis apice breve mucronatis ornata, infra glabra; petiolus circiter 2 mm. longus. *Flores* in racemos 1-2 paucifloros terminales additis aliquando 1-2 axillaribus; bracteae et bracteolae ovatae, mucronatae, margine parce setoso-ciliatae, deciduae. *Calycis* tubus urceolatus, setis hispidis simplicibus curvatis ornatus; lobi 5, ovato-acuminati, praeter margines ciliatos et carinam hispidam glabri, 3 mm. longi, intra lobos appendices triangulares apice fasciculato-setosi. *Petala* 5, insigniter purpurea, latissime obovata, margine ciliata, 1 cm. longa et lata. *Antherae* circiter 5 cm. longae; filamenta 7 mm. longa. *Ovarium* apice dense setosum, stylo superne incrassato. *Capsula* cylindrica, glauca, 7 mm. longa, parce setosa.

South India. Nilgiri hills, *Gardner*; Pulney Hills, 1980-2300 m., *Wight* (K. D. 1090); near Kodaikanal and Perumal, *Bourne*, 68, 968, 1532; Shembag, *Saulière*, 150, 312.

909. **Osbeckia courtallensis,** *Gamble* [Melastomaceae-Osbeckieae]; *O. Kleinii,* Wight et Arn., quoad setas calycinas affinis, foliis minoribus ellipticis nec lanceolatis, et inflorescentia pauciflora differt.

Suffrutex humilis sed lignosus, ramulis teretibus pallide brunneis ultimis subquadrangularibus hispidis. *Folia* elliptica, apice acuta acumine reflexo, basi obtusa, 2-4 cm. longa, 1-2 cm. lata, basi tricostata, margines versus addito nervorum pari inconspicuorum, nervis et nervulis transversis inconspicuis, utrinque setis hispidis infra adnatis supra liberis ornata; petiolus circiter 3 mm. longus. *Flores* in racemos pauci-(3-4-) floros terminales vel axillares; bracteae et bracteolae orbiculares, ciliatae, deciduae. *Calycis* tubus campanulatus, infra setis simplicibus hispidis supra fasciculatis ornatus: lobi 5, ovati, obtusi vel retusi, margine etiam ad medium dorsi ciliato-hispidi, apice fasciculatim longe-setosi; appendices columnares intra lobos siti, apice fasciculato-setosi. *Petala* 5, purpurea, suborbicularia, apice ciliata, 6-7 mm. longa. *Antherae* 7 mm. longae. *Ovarium* dense aureo-setosum, stylo subulato-incrassato. *Capsula* cylindrica, glabra, 10-costata et transverse nervosa, 7-8 mm. longa.

South India. Courtallum, in Tinnivelly, *Wight* (K. D. 1103).

910. **Osbeckia Lawsoni,** *Gamble* [Melastomaceae-Osbeckieae]; *O. Kleinii,* Wight et Arn., affinis, calycis lobis acutis et foliis minoribus differt.

Suffrutex humilis, ramulis tetragonis ultimis hispidis. *Folia* lanceolata, apice acuminata et mucronata, basi acuta, 2-5 cm. longa, 1-1·5 cm. lata, basi tricostata, ad margines addito nervorum pari gracilium inconspicuorum, nervis et nervulis transversis inconspicuis, supra setis gracilibus paucis inferne adnatis ornata, infra ad nervos et sparsim intra nervos hispida: petiolus circiter 3 mm. longus. *Flores* in racemos terminales paniculatos circiter 2-5 floros; bracteae ovatae, acuminatae, hispidissimae; bracteolae ovatae, obtusae, dorso et margine hispidae, deciduae. *Calycis* tubus campanulatus, infra setis simplicibus curvatis supra fasciculatis ornatus; lobi 5, triangulares, acuti, ad apicem setis pectinatis paucis, dorso fere glabri; appendices intra lobos siti cylindrici, apice parce setosi. *Petala* 5, purpurea, late obovata, vix ciliata, circiter 15 mm. longa. *Antherae* curvatae, 7 mm. longae. *Ovarium* infra glabrum, supra longe albosetosum. *Capsula* cylindrica, hispida, 6 mm. longa.

South India. Murchison, in Travancore, at 650 m., Dec., 1893, *Lawson,* 46.

XXXI.—MISCELLANEOUS NOTES.

T. A. Dorrien-Smith.—It is with great regret that we have to record the death of Mr. Thomas Algernon Dorrien-Smith, Lord Proprietor of the Scilly Islands, in his 73rd year, on August 6th. Mr. Dorrien-Smith made the gardens at Tresco Abbey famous by adding extensively to the remarkable collections

of plants accumulated by his predecessor. He was a frequent visitor to Kew, and a generous contributor of plants to the Gardens. Mr. Dorrien-Smith was always glad to receive plants from Kew which could only be grown here under glass, but which in most cases have flourished under the more genial conditions at Tresco. Among the more striking plants which are the pride of the gardens may be mentioned the South African Mesembryanthemums, Agaves from Mexico, Puyas, tree Echiums and Pelargoniums all growing there with astonishing vigour. The remarkable collection of New Zealand and Australian plants under cultivation (largely made by his son, Major A. A. Dorrien-Smith), afford, perhaps, a greater proof of Mr. Dorrien-Smith's success as a cultivator and of the keen interest he took in the acclimatisation of plants unknown to most British gardens.

The conditions at Tresco are no doubt somewhat similar to those of some parts of New Zealand, and it was particularly gratifying to him to find that many plants of interest from New Zealand responded so well to the care and attention he gave them. Tresco affords a fine example of Mr. Dorrien-Smith's skill in cultivating what was not very long ago a bleak, barren and wind-swept island for, in addition to the rare plants grown in his garden, he was the pioneer of the culture of Narcissi on an extensive scale for the supply of early flowers for the English markets. This work was originally undertaken for the purpose of fostering a new industry for the farmers in the Scilly Islands, who, about 35 years ago, were in financial distress owing to the serious competition that had arisen in the early potato market. An account of the Narcissus industry of the Scilly Islands was given in *Kew Bulletin*, 1913, p. 171.

South African Fever Bark.—In a letter to Kew, dated 23rd January, 1918, Mr. I. B. Pole-Evans, Chief of the Division of Botany, Department of Agriculture, Pretoria, has called attention to certain passages in an address to the Cape Town Medical Society on 25th August, 1899, by Dr. J. Maberly, concerning a South African fever bark. While in charge of the Letaba Gold Fields Hospital in the Central Transvaal, where bilious fever is prevalent, Dr. Maberly obtained seeds of the tree which yields this bark, and some of the bark itself, from a traveller who had been afforded practical experience of their efficacy in the low-veld between the Gold Fields and Delagoa Bay, where the tree occurs naturally.

Dr. Maberly's experience with the material proving similar to that of the traveller who had supplied this remedy, he was led to sow some of the seeds with the object of ascertaining the identity of the tree. Unfortunately his plants perished through accident ere this could be done, and although he subsequently secured further seeds, none of those of his second consignment germinated.

In 1917 Dr. Maberly became once more interested in the subject, but the material—a portion of the bark originally obtained by him—sent to Mr. Pole-Evans for identification, proved quite inadequate for the purpose. Dr. Maberly paid a

visit in person to the low-veld with the object of discovering the tree, but failed to do so.

Mr. Pole-Evans himself instituted a search for the source of this remedy, and very soon succeeded in finding the tree, and in ascertaining that the curative properties of its bark in fever cases are well known to the inhabitants of the low-veld.

The material obtained by Mr. Pole-Evans enabled him to recognise the plant as a species of *Croton*, and from that material and a photograph of the tree sent by him to Kew for specific determination, it was possible to recognise it as *C. Gubouga*, S. Moore. This species is widely spread in Nyasaland, Rhodesia, and tropical Portuguese East Africa, but has not previously been recorded from the Transvaal. The locality in which it has been found by Mr. Pole-Evans is on the Olifants River in the Lydenburg district. From a subsequent letter, dated 13th March, 1918, we learn that Mr. Pole-Evans has taken energetic steps for the proper therapeutic investigation of this remedy and the results of his action will be looked forward to with interest.

Rumphius's Herbarium Amboinense.*—The plan of exploring the island of Amboina with the special object of the interpretation and collection of the Rumphian species has been attempted by two botanists, both of whom have met with untimely deaths before their labours were completed. In 1900 Dr. J. G. Boerlage, of Buitenzorg, accompanied by Dr. J. J. Smith, made an excursion to Amboina for the purpose of collecting in their classical localities the plants described by Rumphius. Whilst returning to Java, Dr. Boerlage died of fever, and the results of his field work have unfortunately never been published. On behalf of the Bureau of Science, Manila, Dr. C. B. Robinson took up the same task on July 15th, 1913, and less than five months later he was killed by the natives about 15 kilometres from the town of Amboina (cf. *Kew Bull.* 1914, 192). Dr. Robinson was to have spent at least a year in Amboina and the neighbouring islands, and would no doubt have accomplished a great deal in the identification of the Rumphian species. This is evident from the publication before us, a volume of 595 pages, by Professor E. D. Merrill, at whose suggestion Dr. Robinson undertook the task. Professor Merrill has endeavoured to complete the work from the material available in order that the labours of his late colleague should not have been in vain.

Apart from its great historic interest, the special importance of Rumphius's work to taxonomists is that many of the plants described therein stand alone as the actual "types" of later authors. Of these there are no less than 350. As Professor Merrill says (p. 13): "In botanical literature there are scores of species whose only published descriptions are the brief general statements compiled from the Herbarium Amboinense, from which data alone it is usually impossible for the working systematist to gain any definite idea of the true character of the species":

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* E. D. Merrill, An Interpretation of Rumphius's Herbarium Amboinense; pp. 595 and 2 maps; Bureau of Science, Manila, 1917.

and that "botanists generally have been content to work on the Malayan flora, describing as new the various forms that have appeared in current collections, without making any serious attempt to determine the exact status of species in the same groups based on Rumphian descriptions. Stability in nomenclature demands that the status of these early species be determined as soon as possible, for otherwise many reductions must be eventually made."

In the "Herbarium Amboinense" Rumphius named and described approximately 1,700 plants, the number of printed pages being over 1660 in seven volumes, with about 695 plates. According to Merrill the number of species represented is about 1200. The difficulties attending the identification of these plants, in the absence of any dried material, are obvious—especially so when we consider that the descriptions are non-technical, and that owing to an attack of blindness, Rumphius never even saw some of the figures, which were frequently prepared from other than the actual specimens described. This explains why sometimes the figure does not agree with the description, and why more than one species may be mixed on a single plate.

According to Professor Merrill, there are scores of cases in Loureiro's Flora Cochinchinensis (1790), for example, in which plants from that region are erroneously referred to binomials based alone on Rumphius's work. The same is the case with Burman f., Flora Indica (1768), where the plants described were from Java or some other part of Malaya, whilst the Rumphian references cited mostly prove to represent entirely different species. Professor Merrill has succeeded in referring definitely to binomials about 930 of the 1200 species described by Rumphius, and about 140 additional ones to their respective genera, leaving about 130 not placed under existing binomials. Future monographers should not overlook these puzzles when dealing with Malayan plants.

Professor Merrill, in his nomenclature, follows closely the International rules and recommendations. With regard to this he says (p. 44): "Stability in nomenclature can come only by adhering to definite rules and by critically working out the proper name for each species in conformity with those rules." Hence we find that the author has not hesitated even in changing the well-known names of the soy-bean, the cow-pea, and the pomelo, besides various familiar leguminous and mangrove trees.

The families and genera are arranged after Engler's system, the Rumphian names being cited as synonyms under the binomials to which the author considers they belong. Appended to the systematic arrangement is a list of the Rumphian names arranged in the sequence of the Herbarium Amboinense, giving references to the volume, the page, and the figures under each, and, so far as possible, their binomial equivalents. No doubt some of the determinations may be modified as the result of further research. For instance, *Balanostreblus ilicifolia*, Kurz (sensu stricto), should now be removed from the synonymy of *Taxotrophis ilicifolia*, Vidal (see *Kew Bull.* 1918, pp. 147-153), and *Cordia Myxa* will become *Cordia obliqua*, Willd. (*Kew Bull.* 1918, p. 221). At the

end of the volume is a comprehensive index; two maps, one showing the position of Amboina in the Malay Archipelago and the other the island itself on a large scale, are added. J. H.

Fungi and Disease in Plants.—Mycologists in all parts of the world will welcome the appearance of Dr. E. J. Butler's book on fungus diseases of plants. Dr. Butler was appointed Imperial Mycologist to the Government of India in 1901, and 17 years of hard work, which has included extensive travel over a vast territory, as well as much painstaking research, have given him a position that is unique amongst pathologists. The sub-title of the work indicates that it concerns the diseases of field and plantation crops in India and the East, but in a country such as India the number of crops to be included is obviously large and varied, and ranges from the beans and potatoes of the hills to rubber and sugar cane, a circumstance which gives the book an unusually wide purview.

The volume is divided into (1) a general part of 150 pages, and (2) a special part devoted to diseases of particular crops (365 pages). The first part, though commencing with the rudimentary principles of mycology and plant pathology, goes on to sections on such subjects as immunity, deterioration and control methods. The special part commences with a chapter (92 pages) on diseases of cereals (including rice, sorghum, etc.), and is undoubtedly the most complete summary of this subject in existence. A chapter on pulse crops follows, and the next one on vegetables, roots, and oil seeds, in both of which even the purely European mycologist will find much valuable reading. The remaining portion deals largely with diseases of tropical plants, and includes chapters on dye, drug, and spice crops, fibre crops, sugar cane, tea, coffee, and rubber.

The general account of the diseases and of the particular symptoms is very full, whilst a technical description of the parasitic organism, though also given in considerable detail, is added in small type to save space. Illustrations are numerous and good, there being over 200 figures, a large number of which are new, and several coloured plates. The volume concludes with a bibliography arranged under host plants. It will be noted that diseases of fruit and forest trees are not included, these being reserved for a second volume. Dr. Butler is to be congratulated on the completion of a very careful and laborious piece of work, and the production of a volume which will be invaluable to all pathologists and indispensable to those concerned with tropical crops. A. D. C.

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* Fungi and Disease in Plants. An introduction to the Diseases of Field and Plantation Crops, especially those of India and the East. By E. J. Butler, M.B., F.L.S., Imperial Mycologist, Agricultural Research Institute, Pusa. Thacker, Spink and Co., Calcutta and Simla, 1918, pp. 547, figs. 206.

The Flora of Bermuda.*—In a handy volume of 585 pages, Dr. Britton has given a comprehensive account of the flora of Bermuda, or the Bermudas, which form an isolated group of six larger islands, and about sixty smaller ones, or cays, as well as many rocks or ledges, situated about 568 nautical miles east of Cape Hatteras, and consist of limestone, with many caves, resting on volcanic rocks. The islands, whose total land area is a little over 19 square miles, are scattered over an oblong about 15 miles long by 3 miles wide; they are hilly, their highest point rising to 250 feet above sea-level, and furnish no evidence of ever having been connected with other regions by land. The climate is sub-tropical and warm temperate. About 8·7 per cent. of the total native flora of 709 species (including Cryptogamia) is regarded as endemic. The number of flowering plants enumerated is 146, an increase of 26 on the number in Dr. W. Botting Hemsley's "Botany of the Challenger Expedition, 1885." while the ferns and their allies have diminished from 24 to 19 species. Mosses and hepaticae are represented by 51 species, lichens by 238, and fungi (still incompletely known) by 175. In addition to these 709 species, there are 303 others, which have been introduced through human activities, and have become completely or partially naturalised, and 864 species are recorded as having been cultivated in Bermuda. All the genera are illustrated by text-figures, including analyses. Introduced species are noted at the end of the genera to which they belong, while introduced genera are mentioned under their respective families. A bibliography, list of the principal botanical collections made in Bermuda, a glossary of botanical terms, and an index, complete a very useful volume, moulded on the same general plan as Britton and Brown's "Illustrated Flora of the Northern United States." J. H.

Visit of the Royal English Arboricultural Society.—On Thursday, September 12th, 55 members of the Royal English Arboricultural Society visited the gardens for the purpose of inspecting trees which are likely to be of use for sylvicultural purposes in the British Isles, and to examine the exhibits in the Museum of British Forestry. The party entered at the Lion Gate and after being shown a number of rare trees near the Pagoda proceeded to the Larch collection, where they were specially interested in *Larix occidentalis*. After seeing the collection trees they visited the plantation of this species formed in the Queen's Cottage Grounds from seeds sown in 1909. Some time was also spent in examining the plantation of seedling Elms in the same grounds. Attention was then paid to various Pines, Spruces and Alders. The members were greatly interested in the new flagstaff of Douglas Fir and afterwards spent some time in examining various Ashes, Poplars and Birches. Hybrid Poplars claimed a good deal of attention and many favourable comments were made respecting their prospective value for the

* Flora of Bermuda, by Nathaniel Lord Britton, Ph.D., Sc.D., LL.D. New York, 1918.

production of timber. The Museum of British Forestry and the Museum devoted mainly to Colonial timbers also created a good deal of interest.

Sphagnum for Surgical Work.—In "The Bryologist" xxi. pp. 53-56 (July, 1918), Mr. G. E. Nichols has given an account of the use of Sphagnum for surgical dressings in the United States, where it was officially adopted by the American Red Cross in March, 1918. Previously its use had been restricted to:—(1), the formation of peat; (2), packing by florists and nurserymen; and (3), stable litter. A Sphagnum pad has been found to possess the following advantages over a cotton one:—(1), it will absorb liquids three times as fast; (2), it will absorb 16-22 times its weight of water as against 5-6 times by cotton; (3), greater retentive power, hence the dressings need changing less frequently; (4), absorbed liquids are more uniformly distributed throughout its mass; (5), it is cooler and less irritating; (6), it can be produced at much less expense.

In North America the species belonging to the *Inophloea* group (such as *S. papillosum*, *S. palustre*, *S. imbricatum* and *S. magellanicum*) have been found satisfactory; those with wiry stems are unsuitable. The suitability of a species is affected by its habitat; thus in Western Washington and Vancouver the order of suitability is:—(1), *S. imbricatum*; (2), *S. palustre*; (3), *S. papillosum*; while in the eastern States this order is exactly reversed. Even the same species will vary in the same bog; those specimens from its wettest, most open part being superior to those from parts more shaded or more densely inhabited by heaths, other bushy growths, grasses or sedges. The best Sphagnum-producing regions in the eastern States have been found in eastern Maine and Cape Breton Island, but good material has also been obtained from Michigan.

S. papillosum, Lindb., is the only one of the above-mentioned species which inhabits the British Isles, and is allied to *S. cymbifolium*, Ehrh. (the species most frequently used in Britain), from which it can be distinguished by its ochraceous colour and by its chlorophyllose cells, having the walls adjacent to the hyaline cells papillose, instead of smooth. In Britain it occurs in boggy situations throughout the country, as can be seen from the "Census Catalogue of British Mosses," p. 61 (1907). C. H. W.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

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XXXII.—CONTRIBUTIONS TO THE FLORA OF MACEDONIA: I.

W. B. Turrill.

The present contribution to the flora of Macedonia is based on collections made, in their spare time, by men engaged on active service with the British Salonika Forces. It is not necessary to emphasise the difficulties of preparing and dispatching herbarium specimens under these conditions, but the results, as set forth in this paper, show that it can be done with a considerable amount of success, and will, it is hoped, not only encourage those who are still collecting, but induce others to help in the botanical exploration of Macedonia, a country whose flora has hitherto been less known than that of any other Balkan district.

Since it is not yet possible to publish a complete flora of Macedonia, the writer is saved the considerable trouble of defining the boundaries of an area which for hundreds of years has had no political entity. The following notes on topography, geology, meteorology, and ecology, deal only with the district between Salonika and the Struma Plain and Krusa Balkan traversed by the writer, and in which most of the plants enumerated below were collected.

Geology and Physiography.

A general account of the geology and physiography of Macedonia and southern Serbia, is given by J. Cvijic, "Grundlinien der Geographie und Geologie von Mazedonien und Altserbien," in Petermann's Geogr. Mitteilungen, Erg.-Bd., 34, Nr. 162. The following remarks are based entirely on personal observations and field-notes.

The mountain chains in the eastern Balkans run mainly east and west or north-west and south-east, and this is true not only for the great ranges of the Balkan and Rhodope Mountains but also for the smaller ranges of hills immediately to the north of Salonika, viz., the "Lembert Hills," the Krusa Balkan, Kara-dagh, Bechik-dagh, Belachica Planina, etc. The main trend of the intervening plains is consequently in the same

(51.) Wt. 196—794. 1,125. 12/18. J. T. & S., Ltd. G. 14. Sch. 12.

direction, as, for instance, the Langaza Plain, the Struma Plain, the Butkova and Strumitza valleys. This orientation of the mountains, which is continued in western Asia Minor, has doubtless had considerable influence in the distribution of the plants of this region.

The greater part of the district with which we are immediately concerned consists of plutonic and metamorphic igneous rocks, either actually cropping out on the surface or overlaid by diluvium or alluvium. These rocks are entirely crystalline, consisting of various minerals in varying proportions, but with quartz and mica dominant. The writer found crystals several inches across of this last mineral. Often the mineral constituents are arranged in a foliated manner, and the result is a schist, generally a mica-schist. To the east and south-east of the town of Salonika is an outcrop of crystalline limestone. This stretches northwards nearly to Langaza Lake, and is quarried for road metal to make up the Seres Road and other roads in the immediate vicinity of Salonika. Mount Hortac is largely composed of this rock.

To the east of the Gulf of Salonika the deltas of the Galiko and Vardar are formed of alluvium brought down by these rivers, and the Struma Plain (15 km. wide) is largely filled up with river-borne deposits. To the north-west of Salonika up to the lines of the "Lembert Hills," and further to the west for some distance up the Galiko and Vardar Valleys, a diluvial deposit of varying composition overlies the plutonic rocks. This deposit was met with again on the northern slopes of the Karadagh (really an eastern continuation of the Krusa Balkan) and in the valleys immediately to the south of the Krusa Balkan near Karamudli. Generally it is formed of intermixed stones and pebbles of igneous origin and brown earth more or less sandy in nature. The stones and pebbles are sometimes deposited in layers, but often quite irregularly scattered in the sandy earth, sometimes distinctly water-worn, most often with sharp contours and showing little sign of water action. The whole forms a very loose deposit in which storms and streams have carved deep irregular ravines, "nullahs," sometimes reaching a depth of 40 or 50 ft. One cannot help concluding that at no very distant period great water forces caused these deposits, and that the volume of the water coming from the hills and mountains must have been much greater than that now brought down by the hill streams, most of which seem scarcely able to cut a way through even soft deposits. As in most mountainous districts, a big thunderstorm or other heavy fall of rain causes the streams to increase many times their volume and power in the space of a few hours, as was witnessed in the case of the River Spanc and its tributaries, but even so present conditions fail to account for the extensive diluvial deposits.

On the southern slopes of the "Lembert Hills" a very hard conglomerate composed of large, rounded, igneous pebbles embedded in a fine matrix was found. Projecting masses and boulders of this were covered with lichens and a few mosses, but the latter especially, probably owing to the extreme dryness of the summer, appear to be far from abundant in Macedonia.

On the hill sides soil is either absent or thin and patchy, but the alluvium and diluvium of the valleys and plains give a very rich soil, and it is on such that the farms and villages are for the most part situated.

Water-supply varies with the district. Round Salonika water is scarce and the supply for domestic purposes is obtained either from wells or from the few hill streams. Inland small streams supply water for the flocks, and in the vicinity of every village several shallow wells supplying water all the year have been made, mostly in the banks of streams or sides of nullahs; in some cases hill-side springs have been tapped. The writer analysed a considerable number of water samples in the Karamudli district to the south of the Krusa Balkan, and in all a distinct trace of dissolved iron was discovered, and at times a noticeable taste was imparted by it to the water. Particles of mica generally occur in the spring or well water, and a milkiness due to hydrous silicate of aluminium ("China clay") may sometimes be observed, especially after storms.

Climate.

The chief characteristics of the Macedonian climate are a hot, dry summer and a winter with variously alternating snowy, wet, fine, warm and cold periods. The hot weather usually commences about the middle of May and continues till September. The summer days are generally cloudless and hazy, and such rain as occurs falls usually during local thunderstorms, which are sometimes very severe. July and August are the driest months, while September is also frequently dry. Long spells of drought, lasting from two to six weeks, may occur at any time during the summer. Thunderstorms are most frequent in May and June, increasing in frequency as one moves inland. During the summer the winds are, as a rule, light, with marked diurnal variations, but occasionally strong "Vardar winds" blow from the north or north-east, often lasting for several days, as, for example, in the middle of August last year, when Salonika was burning. In the inland valleys the temperature is frequently higher than on the coast, but nights are cooler inland, and the atmosphere is less moist. A heat haze is common in the early part of the day in the low-lying districts, and in the Struma Plain it has been nicknamed the "Struma Sea."

Winter commences towards the end of October. Warm spells generally follow the first cold period and occur at intervals during the winter. From November to March a succession of more or less intense pressure disturbances affect the Balkan Peninsula, and during these months gales, heavy rainstorms, dull drizzling days, or severe frosts, with short intervals of fine weather are experienced, and mists and fogs are common. The early months of winter are the wettest of the year. The first snow of the winter 1917-1918 was seen on the summits of Mt Olympus on the morning of October 15th, but disappeared during the day, finally coming to remain for the winter on October 24th. The severity of the winter weather increases rapidly as one recedes from the coast, and is especially severe in lofty

regions. Falls of snow may occur from November to April, and are heavier and more frequent inland. January is the month of greatest snowfall, and is, in general, the coldest month. Strong winds are most frequent in January and February, and least in June. The Vardar wind becomes particularly strong as it descends the trough of the Vardar, and frequently accompanies a sudden rise of the barometer. It is a dry wind, accompanied by hard, clear skies. In winter, coming from the snow-clad mountains, it is a cold wind, and even in summer it is usually cool, but the relief afforded by it is minimized, at least along the roads and in camps, by the clouds of gritty dust it raises.

Spring and autumn are both of short duration. The former may be said to cover the months of March and April, and perhaps a part of May, and the latter the end of September and October.

The following table, compiled from statistics given in the "Calendar for 1918, Meteorological Section, R.E., B.S.F." shows the mean, maximum, and minimum temperature and rainfall for each month at Salonika, as based on a series of observations extending from 1893 to 1917:—

	Temperature.			Rainfall.		
	Mean Daily.	Absolute Maximum.	Absolute Minimum.	Average.	Maximum.	Minimum.
January ...	42°F.	67°F.	19°F.	1·47 ins.	3·70 ins.	0·12 ins.
February...	45°F.	70°F.	15°F.	1·42 ins.	4·23 ins.	0·11 ins.
March ...	50°F.	79°F.	27°F.	1·63 ins.	3·21 ins.	0·07 ins.
April ...	57°F.	86°F.	33°F.	1·89 ins.	5·45 ins.	0·23 ins.
May ...	67°F.	96°F.	44°F.	2·36 ins.	6·77 ins.	0·00 ins.
June ...	74°F.	101°F.	53°F.	1·73 ins.	4·09 ins.	0·12 ins.
July ...	80°F.	103°F.	55°F.	1·00 ins.	3·50 ins.	0·03 ins.
August ...	78°F.	105°F.	59°F.	1·22 ins.	2·96 ins.	0·02 ins.
September	72°F.	99°F.	46°F.	1·58 ins.	6·05 ins.	0·06 ins.
October ...	64°F.	88°F.	33°F.	2·09 ins.	6·28 ins.	0·06 ins.
November...	52°F.	79°F.	25°F.	2·71 ins.	8·05 ins.	0·26 ins.
December...	46°F.	71°F.	23°F.	2·40 ins.	5·33 ins.	0·82 ins.

The mean annual temperature is, in accord with the latitude, distinctly warm, viz., 60·6° F., the average monthly mean ranging from 80° F. in July to 42° F. in January. The absolute extremes of temperature recorded are 105° F. in August and 15° F. in February (17° of frost). The total average annual rainfall of 21·5 inches is relatively small for a latitude where the amount of evaporation is necessarily great.

The following additional information, extracted from an article "Sul clima di Salonicco" in Bollettino della Societa Geografica Italiana, December 1916, may be of interest to the ecologist. The rainfall is distributed over 97 days of the year, the wettest month being November, which is also the month during which the heaviest rainfall in 24 hours (3·3 ins.) has been recorded. Thunderstorms occur on some 28

days, the highest monthly figure averaging for May 5·6, June 7·2, July 4·8, and August 3·4 ins. The relative humidity of the air is rather low—65 per cent. on the average of the year—varying between 74 per cent. in December and 54 per cent. in July, whilst the greatest amount of cloud also occurs during the damp month of December, and the least during July and August. The observations of barometric pressure refer to a period of only seven years, but they appear to indicate a principal maximum in November and minimum in July, with a secondary maximum in June and minimum in May.

It is important to remember that all the figures given above refer to observations taken at Salonika, not in the Macedonian hinterland.

Agriculture.

When peaceful conditions return to Macedonia to allow of its economic development, the first place in this will probably be given to agriculture, especially when modern methods are introduced, and rail and road communications permit of quick and secure distribution of produce. At present, cultivation is only carried on in limited areas and by primitive means. For instance, little or no rotation of crops is observed, but land is often allowed to lie fallow for several years, and the only 'dressing' the fields commonly receive is the treading of sheep in spring and autumn. The ground is broken to-day, as it was 2000 years ago, by a one-handled wooden plough, generally made from a single tree trunk and drawn by a pair of oxen or buffaloes. Sowing is accomplished by making a hole with the big toe for each grain, or the seed is merely scattered over the stubble and ploughed in. The soil is naturally very fertile in many of the valleys and plains, and in the middle of July, near the Turkish village of Jeni mah, the writer has seen natives sowing maize immediately after a wheat crop had been reaped—before even the sheaves had been carried. Two shallow-rooted cereal crops in one season, without the application of any fertilizers, could only pay on an extremely rich soil. Reaping, of course, is done by hand, and the unbound sheaves are threshed by the tramping of animals (oxen, cows, donkeys, ponies) round and round the smooth threshing-floor of hardened mud, generally dragging after them a portion of a tree-trunk, which acts as a wooden roller, or a piece of flat timber like a sledge, slightly turned up in front and with a man or children sitting thereon. The grain is winnowed by the mixture of straw and grain being thrown up into the air with forks of several broad prongs, or with wooden shovels. The cereals chiefly cultivated are wheat (bearded and non-bearded varieties), maize, barley, and oats.

Tobacco cultivation is an important industry in Macedonia, and many fields of it are grown in most districts. In the villages the gathered leaves are strung in rows and hung to ferment under the eaves of houses and walls. Cotton has been grown in the Struma Plain and elsewhere. Round Langaza and in other districts the opium poppy is cultivated. For an analytical account of the opium grown in Serbian Macedonia a paper by

Brunetti, quoted in Pharm. Journ., Aug. 31st, 1918, may be consulted. Viticulture is an important industry in the Struma Plain. Several kinds of grapes are grown for wine-making and for manufacture into raisins.

Fruit cultivation should be a financial success in Macedonia if good varieties of trees were introduced and markets rendered available. Many of the fruits are small and evidently little or not at all removed from wild types. In June abundance of luscious cherries—red, white, and black—may be gathered near most villages. In July, plums, pears, and peaches of several kinds are ripe, as is also a small kind of apricot and the white mulberry. Later, quinces, pomegranates, grapes, and figs ripen. Water-melons are brought to perfection in Macedonia, and an interesting account of their cultivation is given in the Gard. Chron., June 1st, 1918, p. 225.

Forestry is non-existent in Macedonia. The scarcity of trees is most noticeable, especially in the district around Salonika. The "Lembert Hills" are absolutely bare except for the shrubby *Quercus coccifera* formation and low herbage. Inland, trees occur, but nearly always singly or in small groups, seldom worthy of the name of woods. *Quercus conferta* seems the tree most frequently used for house timber in the inland districts. It is the commonest tree in many districts and also occurs as a nullah shrub. In the Struma Plain, elm trees reach a good size, and isolated planes are well developed in various localities. The comparative scarcity of trees is probably due to several causes. In the first place the Turks have burnt, or otherwise destroyed, many forests in the Balkans, in their wars with brigands and insurgents of various kinds (see Velenovsky, Fl. Bulg., Suppl. 1. 1898, p. 330). Much timber has been used by the inhabitants for house-building, plough and cart making, etc., and for firewood and charcoal burning, and no trees are systematically planted in the place of those cut down. The flocks of sheep and goats of the nomad shepherds wandering over the hill country, prevent new woods springing up naturally, by nibbling down the young shoots, for in the dry summer, when every blade of grass on the hills is scorched and brown, any young vegetation forms food for the scraggy animals. Lastly the severe winter winds are not encouraging to tree growth.

Ecology.

As a field-collector, the writer found it convenient to divide the flora up into three main divisions, according to the topography of the ground, hill and foothill floras, nullah flora, and plain flora.

Hill and foothill floras.—These were studied on the "Lembert Hills" and Krusa Balkan. The foothill flora in some respects links the hill flora to that of the plains, and, of course, there is no sharp line of demarcation, but since the hills explored nowhere reach above 1000 m. there is no alpine vegetation to consider, and no need to discuss their flora separately from that of their foothills. Undoubtedly the most striking plant

is the Kermes oak, *Quercus coccifera*, which is found on nearly all dry hill slopes, and there constitutes a distinct formation, the "Formatio Quercus cocciferae" of Halácsy. This is related to the "macchie" (maquis) common in many Mediterranean countries, but is of much purer composition. The *Quercus* on the hill-slopes never becomes more than a shrub, 2-6 ft. in height, with very stiff prickly leaves. In April and May the bushes flower more or less freely and the comparatively large acorns are ripe in October. An account of the plant as the host of the "Kermes" insect, which yields a crimson dye material, is given in the *Kew Bulletin*, 1910, pp. 167-169. Amongst the shrubs a large number of annual plants come to maturity, for here their seedling stages are protected from sheep and goats, and a certain amount of moisture is protected from the sun's rays and ensured to their roots. Associated plants include *Asparagus acutifolius*, the tall *Dracunculus vulgaris*, whose inflorescence makes itself conspicuous by its size, colour, and disagreeable odour, *Silybum Marianum* with its variegated green and white leaves, species of *Astragalus*, *Lathyrus*, *Vicia*, and other *Leguminosae*, *Silene* spp., *Dianthus* spp., *Delphinium* spp., *Plumbago europaea* (autumn flowering), *Carduus* spp., and allied thistles, *Aspodelus albus*, *Carex* spp., *Scrophularia* spp., *Verbascum* spp., and various grasses. The bushes are commonly in patches of greater or less extent, and between these are the stony slopes, more or less covered with a short turf of xerophytic grasses, amongst which spring up bulbous plants, or those with corms or rhizomes, *Ornithogalum*, *Romulea*, *Gagea*, *Crocus*, *Muscari*, *Anemone*, etc., or annuals which flower in the spring and ripen their seeds before the summer sun scorches them brown. These latter include *Medicago* and *Trifolium* spp., and numerous other *Leguminosae* common to all the Mediterranean floras, *Myosotis idaea* and *M. collina*, *Helianthemum salicifolium*, *Euphorbia* spp., *Draba verna*, *Alyssum* spp., *Lithospermum apulum*, *Arenaria* spp., and *Cerastium glomeratum*. On the southern slopes of the "Lembert Hills" scarcely any other shrubs accompany the *Quercus coccifera*, but on the northern slopes of the Krusa Balkan the formation passes into a mixed one of evergreen and deciduous shrubs. *Juniperus Oxycedrus* is sometimes as common as *Quercus coccifera*, and other shrubs include *Fraxinus Ornus*, *Pistacia Terebinthus*, *Rhus Cotinus*, *Cornus sanguinea*, *Acer campestre*, *Crataegus*, *Rosa* and *Rubus* spp. Sometimes, especially in the hollows, *Quercus conferta* (as a shrub), *Jasminum fruticans*, *Paliurus Spina-Christi* and *Carpinus duinensis* are found. On the foothills occur clumps of *Paliurus*, sweetbriar, *Crataegus*, *Cistus*, *Linum flavum*, var. *thracicum*, *Jasminum fruticans*, *Ligustrum vulgare* and in the intervening turf aromatic *Labiatae* abound (such as *Thymus* spp., *Salvia* spp., *Calamintha suaveolens*, *Stachys* spp., *Mentha* spp.). *Marsdenia erecta* is a conspicuous plant amongst the hill scrub when in flower, its low bushes, 2-3 ft. in height, being covered with dense white masses of flowers, which emit a strong scent not unlike that of elder. *Anchusa italica* and *Lotus aegeus* are noteworthy for their beauty, as is also *Nigella*

damascena, with its dark blue flowers growing amongst the tall grasses round bushes. *Melica ciliata*, with its long inflorescence of silky white spikelets, stands high above the tangled masses of Rubi sprawling over sweetbriar and other shrubs. The hill slopes are often destitute of anything approaching a compact formation of shrubs. The vegetation is then limited to quickly-fruiting annuals, spring and autumn flowering perennials with strong underground parts, and plants with special protection against the dry summer. Thus, on the southern slopes of the Krusa Balkan, near Karamudli, summer-flowering plants include *Allium pulchellum*, *Digitalis lanata*, *Teucrium Polium*, *Dorycnium intermedium*, *Stachys* spp., *Daucus setulosus*, *Trifolium* spp., *Centaurea* spp., thistles, *Hypericum olympicum*, *Dianthus* spp., *Ononis antiquorum* and, most noticeable of all, species of *Verbascum*, which stand up on hill-sides like grey and yellow sentinels, their vegetative parts and inflorescence covered with a dense tomentum of stellate hairs.

Nullah flora.—Macedonian "nullahs" are structurally of two types, those worn out of the solid rocks of the hills and those cut out of the diluvium of the foothills and plains by streams and storms. They may or may not have a small stream flowing permanently or intermittently through them. Most often they have exceedingly steep sides, and vary in width from 2 or 3 to 20 or 30 yards. Floristically they have this feature in common, that they maintain a flourishing vegetation throughout the hot summer. The steep sides serve as a protection from the sun for at least part of the day, water drains in from the higher levels, and considerable moisture is retained even if no stream runs through them. From higher ground their courses may be traced in summer as winding lines of green shrubs. Common shrubs are *Quercus conferta*, *Fraxinus Ornus*, *Rhus Cotinus*, *Colutea arborescens*, *Coronilla emeroides*, *Carpinus duinensis*, *Cornus sanguinea*, *Tilia argentea*, *Sambucus Ebulus*, and climbers and scramblers are common, including *Lonicera etrusca*, *L. Caprifolium*, *Periploca graeca*, and *Clematis* spp. Besides the ordinary hill and plain plants which find refuge in the nullahs and flower there most of the summer, a number of plants are especially characteristic of these places. Such are *Campanula persicifolia*, *Agrostemma Coronaria*, *Sedum* spp., *Genista* spp., and *Cytisus* spp. A marsh flora may be found on the stream-sides when water permanently runs through the nullah: *Lythrum Salicaria*, *Cyperus longus*, *Juncus*, *Carex*, *Eleocharis*, *Scirpus*, etc., occurring as marginal vegetation to the stream.

Plain flora.—The plains form the richest agricultural land and much of the ground is or has been under cultivation. Many of the fields, however, are purposely left fallow some seasons, and at present numbers are neglected through the exigencies of war. The weed flora is luxuriantly developed in these, and the colour effect is often striking through the masses of flowers of weeds and derelict cultivated plants. Fields of scarlet poppies, pink Silenes, yellow *Hypecoum*, and blue *Lupinus angustifolius* and *Specularia Speculum* spread a

variegated carpet over the Struma Plain in spring. Other common weeds of cultivation include: *Ranunculus arvensis*, blue and scarlet pimpernel, *Euphorbia* spp., *Adonis*, *Glaucium phoenicium*, *Roemeria hybrida*, *Vicia* spp., *Medicago* spp., *Sisymbrium* spp., *Filago arvensis* and *F. germanica*. Between and in the fields are clumps and hedges of *Paliurus Spina-Christi*, *Tamarix tetrandra*, *Jasminum fruticans*, *Rosa* spp., etc. On the banks of the Struma and in the neighbouring swamps a typical marsh flora is developed: *Phalaris arundinacea*, *Iris pseudacorus*, species of *Cyperus*, *Scirpus* and *Juncus*, *Eleocharis palustris*, *Orchis palustris*, etc. Trees of *Salix alba* overhang its banks in places.

As stated above, the parts of Macedonia traversed by the writer are for the most part poor in tree growth. Unfortunately, too, the collection of bulky woody specimens was often curtailed by considerations of weight and available space inside one's pack. Carefully collected specimens of Macedonian trees would be welcomed at Kew. The genera *Prunus* and *Pyrus* should prove very interesting, and when possible flowers, fruits and foliage should be obtained in their different seasons from the same tree. Full notes giving habitat, dates of flowering and fruiting, height and habit of tree, and the diameter of its trunk at six feet from the ground would materially add to the value of the specimens. The following species and genera of trees were observed in addition to cultivated fruit trees: *Quercus conferta*, *Platanus orientalis*, *Populus*, *Salix alba*, *Ulmus*, *Pyrus*, *Prunus*, *Juglans regia*. No coniferous trees were found, but only *Juniperus Oxycedrus* as a shrub.

Floral Succession.

The Macedonian climate, while typically Mediterranean in the long, hot, dry summer, differs from the climates of most other countries bordering this sea in having colder and wetter spells in winter. The spring comes with a rush in March, and merges into summer in May. The hot weather continues till September, and in October the autumn rains revive the parched vegetation and cause a short period of flowering in autumn before the cold winds and snow of winter herald the other extreme from the heat of summer.

The following lists include only the commoner and more interesting plants observed in flower in the successive months.

Jan.-Feb.—*Fumaria officinalis*, *Draba verna*, *Myositis idaea* and *M. collina*, *Euphorbia* sp., *Gagea stenopetala*, *Romulea Bulbocodium*, and *Crocus* sp. The young rosettes of *Silybum marianum* are conspicuous.

March.—*Capsella Bursa-pastoris*, *Sisymbrium Thalianum*, *Leontice Leontopetalum*, *Anemone* spp., *Cerastium glomeratum*, *Viola arvensis*, *Lamium amplexicaule*, *Euphorbia* spp., *Muscari* spp., and *Ornithogalum* spp., in addition to the plants mentioned in the last paragraph, were found in flower.

April.—The spring flora is in its full glory this month. *Leguminosae* are more numerous in flowering species and individuals than the representatives of any other family. *Vicia* spp., *Lathyrus* spp., *Pisum* spp., *Medicago* spp., *Trifolium* spp.,

Astragalus sesameus, *Biserrula Pelecinus*, *Hippocrepis*, *Scorpiurus*, *Ornithopus*, *Lupinus*, *Orobus*, spp., etc., occur everywhere on the hills and in the plains, and *Colutea arborescens*, *Coronilla emeroides*, *Cytisus* and *Genista* spp., were flowering in the nullahs. *Ranunculus rumelicus*, *R. arvensis*, *Hypecoum grandiflorum*, *Roemeria hybrida*, *Glaucium phoeniceum*, *Adonis*, *Papaver* spp., *Cistus villosus*, *Linum flavum*, var. *thracicum*, *Tamarix tetrandra*, *Helianthemum salicifolium*, *Alsine setacea*, *Silene Harrisii* and other species, *Prunus* and *Pyrus* spp., *Scandix*, *Scleranthus* spp., *Tragopogon* spp., *Anthemis* spp., *Chrysanthemum* spp., *Campanula phrygia*, var. *serbica*, *Specularia Speculum*, *Jasminum fruticans*, *Valerianella membranacea*, *Anagallis* spp., *Convolvulus* spp., *Lithospermum* spp., *Linaria simplex* and *L. Pelisseriana*, *Sideritis montana*, *Salvia Horminum*, *Thymus Marschallianus*, *T. macedonicus*, *Cerinthe major*, *Muscari comosum*, *Ajuga Chamaepytis*, *Asphodelus albus*. Many Grasses were just coming out, including species of *Poa*, *Avena*, *Aegilops*, *Bromus*, etc.

May.—Many of the April plants continue flowering. Additional plants which flower this month and give an important facies to the vegetation include:—*Kohlrauschia prolifera*, *K. velutina*, *Dianthus quadrangulus*, *D. tenuiflorus*, *Velezia rigida*, *Nigella* spp., *Hedypnois cretica*, *Nonnea ventricosa*, *Silybum Marianum*, *Delphinium paniculatum*, *Hypericum* spp., *Trifolium* spp., *Vicia* spp., *Lathyrus* spp., *Astragalus* spp., *Lotus aegeus*, *Dorycnium intermedium*, *Genista depressa*, *Onobrychis* spp., *Scutellaria* spp., *Cnicus benedictus*, *Malva* spp., *Cornus sanguinea*, *Alyssum micranthum*, *A. desertorum*, *Stachys plumosa* *Calamintha suaveolens*, *Ziziphora capitata*, *Thymus* spp., *Melittis*, *Sideritis* spp., *Heliotropium suaveolens*, *Anchusa* spp., *Echium* spp., *Cynoglossum pictum*, *Ophrys* spp., *Orchis* spp., especially *O. hircina*, *Papaver* spp., *Achillea* spp., *Xeranthemum annuum*, *Sonchus* spp., *Crepis* spp., *Hieracium* spp., *Zacyntha verrucosa*, *Rhus Cotinus*, *Paliurus Spina-Christi*, *Orobanche* spp., *Geranium* spp., *Carex* spp. (in fruit), *Marsdenia erecta*, *Periploca graeca*, *Digitalis lanata*, *Lysimachia punctata*, *Linaria* spp., *Scabiosa* and *Knautia* spp., *Rubus* and *Rosa* spp., *Campanula* spp. The grasses are in full flower this month:—*Bromus*, *Aegilops*, *Koeleria*, *Elymus*, *Melica*, *Chrysopogon Gryllus*, etc.

June.—*Compositae* and *Labiatae* become the dominant orders this month. Amongst the former may be mentioned *Centaurea* spp., *Carthamnus* spp., *Anthemis* spp., *Inula* spp., *Filago* spp., *Xeranthemum* spp., *Scolymus hispanicus*, *Cichorium Intybus*, *Crupina vulgaris*, and *Asteriscus aquaticus*.

The *Labiatae* include *Prunella alba*, *Stachys* spp., *Phlomis samia*, *P. pungens*, var. *laxiflora*, *Teucrium Polium* and *Nepeta nuda*. Other conspicuous plants are:—*Armeria Adamovicii*, *Hypericum olympicum*, *Vincetoxicum speciosum*, *Clematis* spp., *Linum* spp., *Tunica*, *Gypsophila*, *Dianthus* spp., *Nigella* spp., *Silene* spp., *Allium* spp., *Digitalis* spp., *Trifolium* spp., *Agrostemma Coronaria*, *Alyssum murale*, *Berteroa incana*, *Agrimonia Eupatorium*, *Achillea* spp., *Lavatera thuringiaca*, *Scrophularia Scopoli*, *Delphinium peregrinum*, *Jasione Heldreichii*, and *Crucianella graeca*.

July.—Most exposed vegetation, except that of marshy land, becomes scorched to a straw or pale-brown colour and, with few exceptions other than xerophytic plants, green vegetation and flowering specimens are limited to specially protected localities such as nullahs. Most of the spring and early summer plants have set and shed their seeds. Nevertheless a number of species come into flower this month and several continue flowering which reached their zenith in June. Typical July flowering plants include:—*Centaurea* spp., *Mentha* spp., *Saponaria* spp., *Daucus setulosus*, *Cichorium Intybus*, *Linaria* spp., *Verbascum* spp., *Betonica officinalis*, *Genista ovata*, *Lythrum Salicaria*, *Campanula* spp., *Allium* spp., *Inula* spp., *Hypericum olympicum*, *Tunica illyrica*, *Ononis antiquorum*, *Melissa officinalis*, *Leonurus Cardiaca*, *Marubium peregrinum*, *Erythraea Centaurium*. *Epilobium* spp., *Sambucus Ebulus*, *Silene* spp., *Chondrilla juncea*, *Echinops microcephalus*, *Bupleurum laxum*, *Stachys germanica*, *Portulaca oleracea*, *Lactuca Scariola*, *Xanthium* spp., *Eryngium campestre*, *Nigella arvensis*, *Trifolium* spp.

Aug.-Sept.—These are resting months for the Macedonian vegetation. Very few fresh species come into flower, but a number of individuals of various plants remain here and there flowering or setting seed. *Carduus* and *Carlina* spp., *Cichorium* and other *Compositae*, *Delphinium* spp., *Silene* spp., *Dianthus* spp.

Oct.-Nov.—The autumn rains cause a fresh outburst of flowering, which is, however, small in the number of species. *Plumbago europaea*, *Scilla autumnalis*, *Colchicum*, *Taraxacum megalorrhizon*, *Cyclamen neapolitanum*, *Crocus pulchellus*.

Systematic List.

The plants enumerated in the systematic list were collected by the following persons in the localities given:—

Major G. W. Harris: several very interesting parcels totalling 418 specimens collected in the Struma Plain and Krusa Balkan in the spring and summer of 1918.

Sergt. J. M. Russell: 17 specimens collected in Gumus Dere, a river valley cutting through the Krusa Balkan into the Struma Plain, autumn of 1917, spring of 1918; 79 specimens collected in the Paprat District of the central Krusa Balkan, spring and summer of 1918.

Pte. A. F. Baker: 25 specimens collected for the most part apparently in the neighbourhood of Lake Doiran (Gugunci, etc.), and a few from near Mt. Hortac, but it has not been possible to trace all the localities.

The writer's own collections consisting of 550 specimens and 80 packets of seed made during 1917. Of the latter 40 species germinated and flowered at Kew in 1918. The collections were made in the following districts: at the foot of the "Lembert Hills" (Akbunar, etc.), about 8-10 km. north of Salonika; 6 km. north-east of Lahana; Struma Plain, near Orljak, Kopriva and Ormanli; northern slopes and foothills of the Krusa Balkan near Turica and Gumus Dere; Paprat, Mirova, etc., in the central Krusa Balkan; valley of the R. Spanc (a tributary of the R.

Galiko) at Snevce, Alexsia, etc.; southern slopes of the Krusa Balkan near Karamudli; top of the Krusa Balkan east and west of Baisili; between Karamudli, Moravca and Gramatna; Sarigol, near Kukus.

Throughout this paper the place-names are spelt as in the Austrian 1: 200,000 maps, Salonika and Vodena sheets, except that Saloniki is replaced by the more familiar Salonika. That some standard is necessary is shown by the varied spellings of quite well-known localities. Thus Mt. Hortac is variously given as Hortiac, Hortiach, Hortiasch, Kortiac, Khortiach, Korthiat, Chortiac, Cortasch, Corthiat, etc.

The distribution of each species is given as carefully as possible but further exploration of the Balkans will no doubt increase the known range of a great many species. The terms Greece, Maced., Alb., Mtn., Serb., Bulg., refer in all cases to the countries or districts of Greece, Macedonia, Albania, Montenegro, Serbia and Bulgaria, as these were understood before the "first" Balkan War of 1912. The following works have been consulted in working out the Balkan distribution of the species recorded:—

Halácsy, Conspectus Florae Graecae, 1900-1904. Suppl. I. 1908. Suppl. II. 1912.

Grisebach, Spicilegium Florae Rumelicae, 1843-1844.

Baldacci, Revista della Coll. Bot. Fatta nel 1897 nell' Albania Settentr., 1901.

Rohlena, Beiträge zur Flora Montenegro, 1902-1912.

Pančič, Flora Principatus Serbiae, 1874. Additamenta, 1884.

Velenovsky, Flora Bulgarica, 1891. Suppl. I. 1898. Nachträge, 1902, 1903, 1910.

Ranunculaceae.

Clematis Flammula, *L.*

Krusa Balkan, with rather small flowers, 6-18, *Harris*, 392; hills to south-west of Turica, in flower, 8-6-17, *Turrill*, 405.

Distr. S. Eur., N. Afr., Orient.

Balkans: Greece, Maced., Alb., Mtn.

Clematis Vitalba, *L.*

Between Turica and Kopriva, in flower, 4-6-17, *Turrill*, 370.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: General.

Cream-coloured flowers with a strong, pleasant scent.

Anemone stellata, *Lam.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 126; Krusa Balkan, in flower, 6-18, *Harris*, 350; near Mt. Hortac, south-east of Salonika, in flower, 1-4-17, common, *Baker*, 8a; foothills between Turica and Kopriva, in flower and fruit, 30-4-17, *Turrill*, 126.

Distr. S. Eur., Orient.

Balkans: Greece, Maced., Bulg.

Anemone blanda, *Schott. et Kty.*

Abundant in spring on the hills north of Salonika, in flower, 2 & 3-17, *Turrill*.

Distr. Greece, Maced., Thrace, Orient.

Adonis flammea, *Jacq.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-17, *Harris*, 20, 225; Struma Plain, about 2 km. east of Orljak, with small, bright scarlet flowers and pale green fruits, 23-4-17, *Turrill*, 94.
Distr. S. Eur., Asia Minor and Syria.
Balkans: General.

Thalictrum aquilegifolium, *L.*
Krusa Balkan, in flower, 6-18, *Harris*, 361.
Distr. Cent. and S. Eur., Temp. Asia.
Balkans: General.
There seem no specific differences between this plant and *T. bulgaricum*, Vel. (Flora Bulgarica, p. 4).

Thalictrum angustifolium, *Jacq.*
Krusa Balkan, in flower, 6-18, *Harris*, 362.
Distr. Cent. and S. Eur., Asia Minor.
Balkans: General.

Thalictrum flavum, *L.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris*, 224.
Distr. Eur., Temp. Asia.
Balkans: Mtn., Serb., Bulg., Thrace.

Ranunculus rumelicus, *Griseb.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, Harris, 134; 8-10 km. north of Saloniki, in flower, 13-4-17, *Turrill*, 22.
Distr. Greece, Maced., Serb., Bulg., Thrace, Anatolia.
A low-growing, densely hirsute buttercup, common amongst the grass, etc., of stony slopes.

Ranunculus psilostachys, *Griseb.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 223.
Distr. Greece, Maced., Serb., Bulg.
This species is very closely related to the previous one. It is, however, usually a taller plant, with larger flowers and the roots (napulae) are longer and gradually attenuated, not abruptly ending in fibrillae.

Ranunculus arvensis, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 4; 8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 33.
Distr. Widely distributed as a weed of arable land in Europe and Asia.
One of the commonest weeds of cultivation in Macedonia.

Ranunculus muricatus, *L.*
Between Turica and Kopriva, in flower and fruit, 30-4-17, *Turrill*, 128.
Distr. S. Eur., N. Afr., Orient.
Balkans: Maced., Mtn., Thrace.

Ranunculus sardous, *Crantz.*
Foothills south of Kopriva, on stony slope, in flower and fruit, 15-5-17, *Turrill*, 240.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Alb., Mtn., Bulg.

Nigella damascena, *L.*
Struma Plain and Krusa Balkan, blue flowers, 4 & 5-18, *Harris*, 45, 210; foothills between Turica and Kopriva, in flower, 2-5-17, growing on banks under bushes of *Paliurus*, *Rosa*, *Rubus*, etc., *Turrill*, 138; seeds collected near Turica, 9-6-17, flowered at Kew, 5-7-18, flowers intensely blue, *Turrill* (seed number), 43.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Nigella arvensis, *L.*
Krusa Balkan, in flower and fruit, 6-18, *Harris*, 404; foothills to south of Turica, pale blue flowers, 27-5-17, *Turrill*, 334; near Snevce, in flower and fruit, 24-7-17, *Turrill*, 535.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Alb., Mtn., Serb., Bulg.

Nigella elata, *Boiss.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 64; hills to south-west of Turica, in flower and young fruit, 8-6-17, *Turrill*, 404.
Distr. Previously only recorded from Asia Minor.

Helleborus cyclophyllus, *A. Br.*
Struma Plain and Krusa Balkan, in fruit, 4 & 5-18, *Harris*, 109.
Distr. Greece, Maced., Alb.

Delphinium paniculatum, *Host.*
Struma Plain and Krusa Balkan, in flower, 4 to 6-18, *Harris*, 17, 207, 414; Jenikŏj (Yenikoy) and "Deep Cut Ravine," near water-side, in flower, 18-6-17, *Baker*, 7; field near Turica, in flower, 6-5-17, *Turrill*, 183.
Distr. Eur., Orient.
Balkans: General excl. Greece.

Delphinium orientale, *J. Gay.*
Krusa Balkan, in flower and fruit, 6-18, *Harris*, 352, 371; Paprat District, Krusa Balkan, in flower and fruit, 6-18, *Russell*, 31.
Distr. S.-E. Eur., Orient.
Balkans: Greece, Serb., Bulg.

Delphinium halteratum, *S. et S.*
Krusa Balkan, in flower, 6-18, *Harris*, 366; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 65; Kilindir, in flower, 11-6-17, *Baker*, 8; south slopes of Krusa Balkan, near Karamudli, 29-6-17, *Turrill*, 448.
Distr. Epirus, Thessaly, Maced., Serb., Bulg., Thrace.

Paeonia peregrina, *Mill.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 312.
Distr. Maced., Mtn., Serb., Roumania, Bulg., Thrace, W. Asia Minor.
Not previously recorded south of the Rupel Pass in Macedonia.

BERBERIDACEAE.

Leontice Leontopetalum, *L.*
8-10 km. north of Salonika, 11-3-17, *Turrill.*
Distr. S.E. Eur., Orient.
Balkans: Greece, Maced.

PAPAVERACEAE.

Papaver Rhoeas, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, a form with much dissected leaves with acute segments, *Harris,* 77; field near Turica, in flower, 18-5-17, *Turrill,* 265; seeds collected near Turica, 6-5-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 3.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Papaver strigosum, *Schur.*
Near Turica, in flower and fruit, 18-5-17, *Turrill,* 267; seeds collected near Turica, 6-5-17, flowered at Kew 15-6-18, *Turrill* (seed-number), 4.
Distr. Eur., N. Afr., Orient.
Balkans: Greece.

Papaver hybridum, *L.*
On a dry bank near Turica, in fruit, 24-5-17, *Turrill,* 308a.
Distr. W. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Glaucium corniculatum, *Curt.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris,* 206. It is not possible to be certain from the dried specimen whether this plant had scarlet or yellow flowers, possibly it had the latter, when it would be the variety *flaviflorum,* DC.

Glaucium corniculatum, *Curt.*, var. **phoeniceum**, *DC.* (*G. phoeniceum,* Crantz).
Struma Plain, about 2 km. east of Orljak, bright scarlet flowers, 26-4-17, *Turrill,* 102; seeds collected near Turica, 9-6-17, flowered at Kew, 25-6-18, scarlet flowers, *Turrill* (seed number) 44.
Distr. (of sp. and var.) Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Roemeria hybrida, *DC.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 80; Struma Plain, about 2 km. south-east of Orljak, blue flowers, 26-4-17, *Turrill,* 104.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced.
Fedde in Engler, Pflanzr. Papav., p. 241 (1909), says the most northern example of this species hitherto recorded came from Salonika. Velenovsky does not record it from Bulgaria.

Hypecoum grandiflorum, *Benth.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris*, 218; near Gumus Dere, in flower, 4-18, *Russell*, 1; 8-10 km. north of Saloniki, in flower and fruit, 13-4-17, *Turrill*, 54; seeds collected near Turica, 12-5-17, flowered at Kew, 1-6-18, *Turrill* (seed-number), 21.
Distr. S. Eur.
Balkans: Greece, Serb., Bulg.

FUMARIACEAE.

Corydalis Marschalliana, *Pers.*
Near Gumus Dere, in flower, 5-18, *Russell*, 9.
Distr. S.E. Eur., Asia Minor.
Balkans: Maced., Serb., Bulg., Thrace.

Fumaria officinalis, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 85.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

CRUCIFERAE.

Rapistrum Linneanum, *Boiss. et Reut.*
Between Turica and Kopriva, in flower and fruit, 25-5-17, *Turrill*, 312.
Distr. S. Eur., N. Afr.
Balkans: Greece.

Cardamine graeca, *L.*
Near Gumus Dere, in flower, 4-18, *Russell*, 11.
Distr. S.-E. Eur., Orient.
Balkans: General.

Erysimum repandum, *L.*
8-10 km. north of Salonika, in flower and fruit, 13-4-17, *Turrill*, 44.
Distr. *E.* Eur., N. Afr., Orient.
Balkans: General.

Erysimum atticum, *Heldr. et Sart.*
Southern slopes of Krusa Balkan, south-east of Karamudli, yellow flowers and young fruits, 20-6-17, *Turrill*, 425.
Distr. Greece.

Sisymbrium Sophia, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 82; weed in cultivated ground near Turica, in fruit, 14-5-17, *Turrill*, 209.
Distr. Eur., N. Afr., Orient, Cent. Asia.
Balkans: General.

Sisymbrium orientale, *L.*
Weed in cultivated ground near Turica, long pods, 14-5-17, *Turrill*, 208.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Eruca sativa, *Lam.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 293.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Bulg., Thrace.

Berteroa incana, *DC.*
Southern slopes of Krusa Balkan, south-east of Karamudli, in flower and fruit, 20-6-17, *Turrill*, 430.
Distr. N. and Cent. Eur., Orient, N. Asia.
Balkans: Maced., Bulg.

Erophila verna, *Meyer.*
Abundant in February on the hills to the north of Salonika, *Turrill.*
Distr. Eur.
Balkans: General.

Alyssum desertorum, *Stapf.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18; *Harris*, 132; near Turica, small yellow flowers and glabrous fruits, 7-5-17, *Turrill*, 184; seeds collected near Turica, 7-5-17, flowered at Kew, 5-6-18, *Turrill* (seed-number), 7.
Distr. S.E. Eur., Orient, N. Asia.
Balkans: General.

Alyssum micranthum, *M. B.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 51; 8-10 km. north of Salonika, small yellow flowers and hairy fruits, 13-4-17, *Turrill*, 32; near Turica, 7-5-17, *Turrill*, 185; seeds collected near Turica, 7-5-17, flowered at Kew, 5-6-18, *Turrill* (seed-number), 6.
Distr. S.E. Eur., Orient.
Balkans: Serb., Bulg., Thrace.

Alyssum murale, *W. K.*
South-east of Karamudli, yellow flowers, 20-7-17, *Turrill*, 429.
Distr. S.-E. Eur., Orient.
Balkans: General.

Camelina sativa, *Cr.*
Struma Plain, about 2 km. east of Orljak, in flower and fruit, 26-4-17, *Turrill*, 101.
Distr. Eur., Orient.
Balkans: Bulg.

Lepidium latifolium, *L.*
Between Kasimli and Snevce, in flower, 1-7-17, *Turrill*, 459.
Distr. Cent. and S. Eur., N. Afr., Orient, N. Asia.
Balkans: Greece, Bulg., Thrace.

Lepidium ruderale, *L.*
Near Alexsia, in flower and fruit, 24-7-17, *Turrill*, 528.
Distr. Eur., Orient, N. Asia.
Balkans: General.

RESEDACEAE.

Reseda Luteola, *L.*

Struma Plain and Krusa Balkan, in flower and fruit, 5 & 6-18, *Harris*, 183, 337.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: Greece, Maced., Serb., Bulg., Thrace.

CISTACEAE.

Cistus villosus, *L.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 32; hill slopes south-west of Turica, red flowers, 5-5-17, *Turrill*, 155.

Distr. S. Eur., N. Afr., Orient.

Balkans: Greece, Mtn., Thrace.

Shrub to 2 ft. in height.

Helianthemum salicifolium, *Pers.*

About 3 km. north-east of Orljak, in flower and fruit, 20-4-17, *Turrill*, 82; foothills between Turica and Kopriva, in flower and fruit, 30-4-17, *Turrill*, 127; seeds collected between Turica and Kopriva, 7-5-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 11; seeds collected near Jeniköj, 22-4-17, flowered at Kew, 5-7-18, *Turrill* (seed-number), 75.

Distr. Cent and S. Eur., N. Afr., Orient.

Balkans: General.

The flowers open early in the day and the petals fall about noon.

Helianthemum guttatum, *L.*, var. **plantagineum,** *Gren. et Godr.*

Hill slopes south-west of Turica, in flower, 5-5-17, *Turrill*, 161.

Distr. S. Eur., N. Afr., Orient.

Balkans: Greece, Alb.

VIOLACEAE.

Viola odorata, *L.*

Near Gumus Dere, in flower, 4-18, *Russell*, 12.

Distr. Eur., N. Afr., Orient, Cent. Asia.

Balkans: General.

Viola Kitaibeliana, *R. et S.*

Struma Plain and Krusa Balkan, in fruit, 4 & 5-18, *Harris*, 55.

Distr. Cent. and S.-E. Eur., N. Afr.

Balkans: General.

Viola tricolor, *L.*

Krusa Balkan, in flower, 6-18, *Harris*, 411.

Distr. Eur., Orient, Temp. Asia.

Balkans: General.

POLYGALACEAE.

Polygala monspeliaca, *L.*

Between Turica and Kopriva, in flower, 7-5-17, *Turrill*, 181.

Distr. S. Eur., N. Afr., Orient.

Balkans: Greece, Mtn.

Agrostemma Githago, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 106.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Agrostemma Coronaria, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 50; south-east of Karamudli, southern slopes of Krusa Balkan, bright magenta flowers, 20-6-17, *Turrill,* 423.
Distr. S. Eur., Orient, Himalayas.
Balkans: General.

Viscaria atropurpurea, *Griseb.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris,* 305; Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 92.
Distr. Maced., Bulg., Thrace.

Melandryum sylvestre, *Roehl.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 321.
Distr. Eur.
Balkans: Bulg.

Silene venosa, *Aschers.* var. **commutata,** *Gürke.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 81: Paprat District, Krusa Balkan, in fruit, 6-18, *Russell,* 70.
Distr. (of var.) S.-E. Eur., Orient.
Balkans: Greece, Maced.

Silene conica, *L.*
Seeds collected at Kopriva, 15-5-17, flowered at Kew, 4-6-18, *Turrill* (seed-number), 24.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Silene subconica, *Friv.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 43, 78, 124, 265; hill-slopes south-west of Turica, pink corollas, inflated fruiting calyces, 5-5-17, *Turrill,* 153.
Distr. Maced., Serb., Bulg., Thrace.

Silene Harrisii, *Turrill,* species nova affinis *S. coniflorae,* Otth., sed calyce longe et patule hirsuto, dentibus longioribus facile distinguenda.
Planta annua, erecta, usque ad 2·8 dm. alta, caulibus teretibus dense puberulis. *Folia* basilaria lineari-spathulata, apice acuta, in petiolum gradatim angustata, 2-3 cm. longa, 3·5—4·5 mm. lata, costa media conspicua, nervis lateralibus indistinctissimis, caulina lineari-lanceolata, apice acute attenuata, 2-4 cm. longa, usque ad 3 mm. lata, utrinque puberula, quinquenervia, sessilia. *Inflorescentia* 4-8-floris. *Calyx* cylindrico-conicus, 1·5 cm. longus, 4 mm. diametro, dentibus 5 acutissimis

8 mm. longis, hirtis albis patulis 2-3 mm. longis instructus, 30-nervis. *Corolla* rosea, petalis 1·8 cm. longis, limbo obcordato basi angustato 5 mm. longo, 2·5 mm. lato, ungue alato apice cum dentibus lateralibus duobus 1·5 mm. longis instructo. *Stamina* 5, antheris 1·5 mm. longis, filamentis 1·25 cm. longis. *Ovarium* conico-cylindricum, 2·75 mm. altum, 1·5 mm. diametro; stigmata 4·5 mm. longa.

Struma Plain, in flower, 4 & 5-18, *Harris*, 164; Struma Plain about 2 km. east of Orljak, pink flowers, 26-4-17, *Turrill*, 103.

Silene gallica, *L.*

8-10 km. north of Salonika, small pink flowers, 13-4-17, *Turrill*, 50.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: Greece, Mtn., Serb.

Silene trinervia, *Seb. et Maur.*

Struma Plain and Krusa Balkan, in flower, 6-18, *Harris*, 340; between Kurkut and Alexsia, pink flowers, 15-6-17, *Turrill*, 414.

Distr. S.-E. Eur.

Balkans: General.

Silene Roemeri, *Friv.*

West of Karamudli, near the dried-up bed of a branch of the R. Spanc, cream flowers, long inflorescences, 16-7-17, *Turrill*, 511.

Distr. Maced., Alb., Serb., Bulg.

Silene italica, *Pers.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 46, 310.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

Silene Skorpili, *Vel.*

Krusa Balkan, in flower, 6-18, *Harris*, 374; Akbunar, about 8 km. north-west of Salonika, in flower, 8-17, *Turrill*, 546.

Distr. Bulg., Thrace.

The upper part of the stem and the calyces are very viscous.

Saponaria officinalis, *L.*

Between Kasimli and Snevce, white flowers with very sweet scent, 1-7-17, *Turrill*, 463.

Distr. Eur., Orient, Cent. Asia.

Balkans: General.

Saponaria Vaccaria, var. **grandiflora,** *Fisch.*

Struma Plain and Krusa Balkan, in flower, 5-6-18, *Harris*, 212, 407.

Distr. Cent. and S. Eur., Orient, Temp. Asia.

Balkans: Greece and probably General.

Gypsophila muralis, *L.*
Near Trinity Well, south-west of Turica, pink flowers, 7-5-17, *Turrill*, 400.
Distr. Eur., Orient, Cent. Asia.
Balkans: Thessaly, Maced., Serb., Bulg.

Tunica Saxifraga, *Scop.*
Hills between Turica and Gumus Dere, pinkish flowers, 5-6-17, *Turrill*, 381.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Tunica illyrica, *Boiss.*
Southern slopes of Krusa Balkan, near Karamudli, white flowers, 29-6-17, *Turrill*, 445; north of Karamudli, white flowers, 8-7-17, *Turrill*, 479.
Distr. S.-E. Eur.
Balkans: General.
In 445 the calyx, in marked contrast with the glandular stems and peduncles, is quite glabrous; in 479 it is more or less roughly hirsute.

Dianthus Frivaldskyanus, *Boiss.*
Akbunar, about 8 km. north-west of Salonika, 10-18, *Turrill*, 547.
Distr. Maced., Bulg., Thrace.

Dianthus tenuiflorus, *Griseb.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 199, 215, 268; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 79; Uladaja and Kilindir, generally among rocks, in flower, 12-6-17, *Baker*, 6; hills between Turica and Gumus Dere, flowers deep to pale pink, 25-5-17, *Turrill*, 320.
Distr. Maced., Serb., Bulg., Thrace.
This pink is abundant in Eastern Macedonia and shows a considerable amount of variation in the size and colour of the flowers and in the amount of the indumentum. The size of the flowers, as Dr. Stapf kindly pointed out to the writer, in many species of Dianthus is correlated with sexual variations. An examination of examples of *D. tenuiflorus* showed this to be the case in this species. Thus *Harris*, 268, *Russell*, 79, and *Turrill*, 320, have flowers up to 2 cm. in length, possessing well-developed stamens, with large anthers and styles, and in every way typically hermaphrodite. On the other hand, *Harris*, 199 and 215, have flowers about 1·7 cm. long and the stamens are more or less abortive, the plant being functionally female.

Dianthus ambiguus, *Panč.*
Uladaja Ravine, on hillside, in flower, 12-6-17, *Baker*, 19.
Distr. Balkans, from Macedonia northwards.

Dianthus leptopetalus, *Willd.*
Foothills near Turica, white flowers, 9-6-17, *Turrill*, 406.
Distr. Maced., Thrace, S. Russia, Caucasus, Songaria.

Dianthus quadrangulus, *Vel.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 198; Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 63; Struma Plain, between Kopriva and Lake Butkova, coll. Staff-Serg. Firth, 1-5-17, *Turrill,* 135; hills between Turica and Gumus Dere, dark-red flowers in heads, 25-5-17, *Turrill,* 319.
Distr. Maced., Bulg., Thrace.

Kohlrauschia prolifera, *Rchb. f.*
Foothills near Turica, in flower and fruit, 24-5-17, *Turrill,* 298; seed collected on southern slopes of Krusa Balkan, west of Karamudli, 30-6-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 66.
Distr. Eur., Orient.
Balkans: General.

Kohlrauschia velutina, *Rchb. f.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris,* 12; between Kopriva and Turica, in flower, 1-5-17, *Turrill,* 134; foothills near Turica, 24-5-17, *Turrill,* 299.
Distr. S.-E. Eur., N. Afr., Orient.
Balkans: Maced., Greece.

Velezia rigida, *L.*
On dry banks near Turica, small pink flowers, 24-5-17, *Turrill,* 306.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Bulg.

Moenchia mantica, *Brtl.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 127, 238; 8-10 km. north of Salonika, in flower, 13-4-17, *Turrill,* 17.
Distr. Cent. and S. Eur., Orient.
Balkans: General.
Velenovsky's subspecies *bulgarica* does not appear to be anything more than a form of this plant.

Arenaria leptoclados, *Guss.*, var. **viscidula,** *Rouy et Fouc.*
Struma Plain, between Kopriva and Kopriva Bridge, in flower and fruit, 26-5-17, *Turrill,* 323.
Distr. Eur., N. Afr., Orient.
Balkans: Greece.

Alsine setacea, *W. K.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 307; 8-10 km. north of Saloniki, 13-4-17, *Turrill,* 15.
Distr. Cent. and S.-E. Eur.
Balkans: General.

Alsine glomerata, *Fnzl.*
Foothills south of Turica, 27-5-17, *Turrill,* 340.
Distr. S.-E. Eur.
Balkans: Maced., Serb., Bulg., Thrace.

Spergula pentandra, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris,* 128.
Distr. Eur., N. Afr., Orient.
Balkans: Maced., Greece.

Spergularia rubra, *Wahl.*
Gumus Dere, pink flowers, 7-6-17, *Turrill,* 385.
Distr. Eur., Orient, Cent. Asia.
Balkans: General.

LINACEAE.

Linum gallicum, *L.*
Hills between Turica and Gumus Dere, small yellow flowers, 5-6-17, *Turrill,* 380.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Bulg.

Linum flavum, *L.*, var. **thracicum,** *Griseb.*
Struma Plain and Krusa Balkan, yellow flowers, 4 to 6-18, *Harris,* 17, 95, 96, 276, 403; foothills between Orljak and Turica, a low shrub with yellow flowers, 29-4-17, *Turrill,* 114.
Distr. (of var.) Maced., Bulg., Thrace.

Linum angustifolium, *Huds.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 309.
Distr. W. and S. Eur., Orient.
Balkans: Greece, Maced., Mtn., Bulg., Thrace.

Linum tenuifolium, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris,* 103, 110, 248, 320; foothills south-west of Turica, petals white with blue veins at base, 27-5-17, *Turrill,* 342.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Linum usitatissimum, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 245.
Distr. Introduced into many countries.
Balkans: Greece.

MALVACEAE.

Althaea officinalis, *L.*
Krusa Balkan, in flower, 6-18, *Harris,* 384; near Alexsia, in flower, 24-7-17, *Turrill,* 524.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Maced., Alb., Mtn., Bulg.

Althaea pallida, *W. K.*
Krusa Balkan, in flower and fruit, 6-18, *Harris,* 375.
Distr. S.-E Eur., Orient.
Balkans: General.

Lavatera thuringiaca, *L.*
Southern slopes of Krusa Balkan, west of Karamudli, in flower, 21-6-17, *Turrill*, 434.
Distr. Cent. and S.-E. Eur., Orient, Cent. Asia.
Balkans: General (rare in Greece).
Our plant is the *Lavatera ambigua* of De Candolle, originally described (in DC. Prodr., I., p. 440) from Neapolitan specimens and differing from the typical plant in the more acute lobes of the upper leaves, with the middle lobe twice the length of the lateral ones. The dentation is more prominent, with the teeth more acute. This form, scarcely worth even varietal rank, has also been recorded from Greece (Hal., Consp. Fl. Gr., I., p. 267).

Lavatera punctata, *All.*
Foothills between Turica and Kopriva, fine pink flowers, 29-5-17, *Turrill*, 352.
Distr. S. Eur., Orient.
Balkans: Greece, Maced., Serb.

Lavatera trimestris, *L.*
Uladaja Ravine, near water-side, in flower, 11-6-17, *Baker*, 18; western end of Krusa Balkan, overlooking Lake Doiran, large pink flowers, 1-7-17, *Turrill*, 467.
Distr. S. Eur., Orient.
Balkans: Greece.

Malva silvestris, *L.*
Abundant in waste places about Turica and Kopriva, in flower and fruit, 29-5-17, *Turrill*, 351.
Distr. Eur., N. Afr., Orient, Cent. Asia.
Balkans: General.

Malva rotundifolia, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 4-5-18, *Harris*, 93.
Distr. Eur., Orient.
Balkans: General.

Tiliaceae.

Tilia argentea, *Desf.*
Nullah to south of Turica, 6-5-17, *Turrill*, 168.
Distr. S.-E Eur., Bithynia.
Balkans: General.

Hypericaceae.

Hypericum olympicum, *L.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 197, 398; hills between Turica and Gumus Dere, large yellow flowers, 5-6-17, *Turrill*, 379; between Kasimli and Sneyce, flowers and young fruits, 1-7-17, *Turrill*, 465.
Distr. Greece, Maced., Bulg., Thrace, Asia Minor.

Hypericum perforatum, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 149; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 85; foothills between Turica and Kopriva, in flower, 2-6-17, *Turrill*, 360; south of Karamudli, in flower, 15-7-17, *Turrill*, 495.
Distr. Eur., Orient, Cent. Asia.
Balkans: General.

Hypericum Montbretii, *Spach.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 150.
Distr. Maced., Bulg., Asia Minor.

Hypericum rumelicum, *Boiss.*
Gugunci and "Buc-hill," in flower, 8-5-17, *Baker*, 24.
Distr. Maced., Serb.

ACERACEAE.

Acer campestre, *L.*
On the hills south-west of Kopriva, in fruit, 15-5-17, *Turrill*.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Maced., Serb., Bulg.

GERANIACEAE.

Geranium sanguineum, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 52; hills west by south of Kopriva, large, brightly-coloured flowers, under bushes, 15-5-17, *Turrill*, 227.
Distr. Eur. (excl. north), Orient.
Balkans: General.

Geranium rotundifolium, *L.*
Near Trinity Well, south-west of Turica, in flower and fruit, 7-5-17, *Turrill*, 402.
Distr. Eur., N. Afr., Orient, Cent. Asia.
Balkans: General.

Geranium columbinum, *L.*
Paprat District, Krusa Balkan, in flower and fruit, 6-18, *Russell*, 59; seed collected near Turica, 22-5-17, flowered at Kew, 6-6-18, *Turrill* (seed-number), 13.
Distr. Eur., Orient, Temp. Asia.
Balkans: General.

Geranium dissectum, *L.*
Seeds collected between Turica and Kopriva, 9-5-17, flowered at Kew, 6-6-18, *Turrill* (seed-number), 27.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Geranium molle, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 129.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Geranium lucidum, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris,* 214; foothills between Turica and Kopriva, in flower and fruit, 30-4-17, *Turrill,* 121.
Distr. Cent. and S. Eur., N. Afr., Orient, Cent. Asia.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Erodium cicutarium, *L'Her.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris,* 168, 183.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.
The flowers open in the early morning and the petals fall after noon.

ZYGOPHYLLACEAE.

Tribulus terrestris, *L.*
Krusa Balkan, in flower and fruit, 6-18, *Harris,* 365; just south of Karamudli, in flower and fruit, 23-7-17, *Turrill,* 523.
Distr. S. Eur., N. and S. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.
Prostrate, spreading branches, pale yellow corollas.

RUTACEAE.

Dictamnus albus, *L.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris,* 205, 406.
Distr. Eur., Orient, Temp. Asia.
Balkans: General.

Peganum Harmala, *L.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris,* 327.
Distr. S. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

RHAMNACEAE.

Paliurus Spina-Christi, *Mill.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 163; found generally around Gugunci, Doiran, and Kilindir, in flower, 1-5-17, *Baker,* 5; Struma Plain, about 3 km. east of Orljak, foliage and old fruit, 20-4-17, *Turrill,* 78; foothills between Turica and Kopriva, in flower, 17-5-17, *Turrill,* 257.
Distr. Eur., Orient.
Balkans: General.
The yellowish-green flowers attract a great many flies and ladybirds, which hang on the inflorescences and walk over the flowers.

ANACARDIACEAE.

Pistacia Terebinthus, *L.*
Hills west by south of Kopriva, in young fruit, 15-5-17, *Turrill,* 229.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Rhus Cotinus, *L.*

Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 8, 27; Krusa Balkan, in flower, 6-18, *Harris*, 409; hillsides, Gumus Dere, in flower, 19-5-17, *Turrill*, 274.

Distr. S. Eur., Orient.

Balkans: General.

The conspicuously red-haired pedicels make this a prominent shrub.

LEGUMINOSAE.

Genista ovata, *W.K.*

Western end of Krusa Balkan, overlooking Lake Doiran, yellow flowers, 2-7-17, *Turrill*, 470.

Distr. S.-E. Eur.

Balkans: General.

Genista depressa, *M.B.*

Struma Plain and Krusa Balkan, in flower, 4 to 6-18, *Harris*, 6, 308, 406; hills between Turica and Gumus Dere, yellow flowers, 25-5-17, *Turrill*, 316.

Distr. Bulg., Thrace, Asia Minor.

Cytisus hirsutus, *L.*

6 km. north-east of Lahana, in flower, 19-4-17, *Turrill*, 72.

Distr. Cent. and S.-E. Eur., Bithynia.

Balkans: General.

Cytisus austriacus, *L.*

Near Karamudli, yellow flowers, 23-6-17, *Turrill*, 436.

Distr. Cent. and S.-E. Eur.

Balkans: General.

Lupinus angustifolius, *L.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 13, 226; near Gumus Dere, in flower, 5-18, *Russell*, 4; Struma Plain, about 3 km. east of Orljak, blue flowers, 20-4-17, *Turrill*, 89.

Distr. S. Eur., N. Afr., Orient.

Balkans: Greece.

Ononis antiquorum, *L.*

Krusa Balkan, in flower, 6-18; *Harris*, 373; southern slopes of Krusa Balkan, in flower, 12-7-17, *Turrill*, 487.

Distr. S.-E. Eur., Orient.

Balkans: Greece, Maced.

Ononis spinosa, *L.*

Seed probably collected south of Lake Doiran, flowered at Kew, 20-9-18, *Baker* (seed-number), 4.

Distr. Eur., Orient, Temp. Asia.

Balkans: General.

Medicago falcata, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, a hirsute form, *Harris*, 94; Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 176, 397; between Turica and Kopriva, yellow flowers, 4-6-17, *Turrill*, 373.
Distr. Eur., Orient, Cent. Asia.
Balkans: General.

Medicago sativa, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 121; east of Karamudli, blue flowers, 9-7-17, *Turrill*, 482.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Serb., Bulg.

Medicago orbicularis, *All.*
Seeds collected near Turica, 28-5-17, flowered at Kew, 21-6-18, *Turrill* (seed-number), 15.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Mtn., Serb., Bulg., Thrace.
Two fruits sometimes twine together.

Medicago disciformis, DC.
8-10 km. north of Salonika, in flower and fruit, 13-4-17, *Turrill*, 29.
Distr. S. Eur., Asia Minor.
Balkans: Greece, Maced.

Medicago rigidula, *Desr.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris*, 298; 8-10 km. north of Salonika, yellow flowers, hairy spinous fruits, 13-4-17, *Turrill*, 42; seeds collected near Turica, 22-5-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 29.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Medicago minima, *Grufberg.*
Grown from seed collected near Turica, 22-5-17, flowered at Kew, 12-6-18, *Turrill* (seed-number), 12.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Medicago minima, *Grufberg*, var. **mollissima,** *Koch.*
Struma Plain, about 3 km. east of Orljak, *Turrill*, 83.
Distr. As species.

Medicago maculata, *Willd.*
Foothills between Orljak and Turica, 29-4-17, *Turrill*, 116.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Medicago lupulina, *L.*
Near Alexsia, small yellow flowers, 24-7-17, *Turrill*, 525.
Distr. Eur., N. Afr., Asia.
Balkans: General.

Melilotus sulcata, *Desf.*
8-10 km. north of Salonika, bright yellow flowers, 13-4-17, *Turrill,* 37.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece.

Melilotus alba, *Desr.*
Near River Spanc, south of Snevce, small white flowers, 24-7-17, *Turrill,* 532.
Distr. S. Eur., Orient, Temp. Asia.
Balkans: Greece, Maced., Serb., Bulg.

Melilotus indica, *All.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 146.
Distr. Spontaneous in most temperate and sub-tropical regions.

Trifolium medium, *L.*, var. **pseudomedium,** *Vel.* (*T. medium,* L., subsp. *balcanicum,* Vel.)
Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 20.
Distr. (of var.) Greece, Serb., Bulg.

Trifolium pratense, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 51; near Snevce, deep red flowers, 24-7-17, *Turrill,* 537.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Trifolium ochroleucum, *Huds.*
Struma Plain, about 2 km. east of Orljak, whitish flowers, 28-4-17, *Turrill,* 110.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Trifolium ochroleucum, *Huds.*, var. **roseum,** *Presl.*
South-east of Karamudli, in flower, 20-6-17, *Turrill,* 424.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Trifolium Cherleri, *L.*
Struma Pain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 113; seed collected on southern slopes of Krusa Balkan, near Karamudli, 17-6-17, flowered at Kew, 25-6-18, *Turrill* (seed-number), 51.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Alb., Mtn., Herz., Thrace.
The fruiting heads of this species, with their long, hairy, persistent calyces, fall off entire and sticking together form quite large matted masses on some of the stony hill-slopes.

Trifolium hirtum, *All.*
Between Turica and Kopriva, red flowers, 5-5-17, a very hairy plant, *Turrill,* 150.
Distr. S. Eur., Orient.
Balkans: General.

Trifolium Lagopus, *Pourr.*
Hill-slopes south-west of Turica, pinkish flowers, 5-5-17, *Turrill,* 154.
Distr. S. Eur., Orient.
Balkans: Serb., Bulg., Thrace.

Trifolium stellatum, *L.*
Near Turica, in fruit, 5-18, *Turrill.*
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Thrace.

Trifolium arvense, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 59; seeds collected on the southern slopes of the Krusa Balkan, near Karamudli, 29-6-17, flowered at Kew, 25-6-18, *Turrill* (seed-number), 61; Struma Plain, about 3 km. east of Orljak, in flower, 20-4-17, a form with long leaflets and cylindrical heads, *Turrill,* 76; hills west by south of Kopriva, in flower, 15-5-17, a very slender form, *Turrill,* 235; dry southern slopes of the Krusa Balkan, near Karamudli, in flower, 24-7-17, a stunted form of which the upper shoots were apparently eaten or cut off, and the lower parts then became semi-woody and gave rise to fresh branches, *Turrill,* 543.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Trifolium tenuifolium, *Ten.*
Dry southern slopes of Krusa Balkan, near Karamudli, narrow leaflets, white flowers, 24-7-17, *Turrill,* 542.
Distr. S.-E. Eur.
Balkans: Greece, Maced., Alb.

Trifolium angustifolium, *L.*
Paprat District, Krusa Balkan, in fruit, 6-18, *Russell,* 55.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Trifolium purpureum, *Lois.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 155; Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 60; between Turica and Kopriva, large heads with red flowers, 17-5-17, *Turrill,* 252.
Distr. S. France, Italy, Balkans, Orient.
Balkans: General.

Trifolium striatum, *L.*
Between Turica and Kopriva, white flowers, 21-5-17, *Turrill,* 285; seeds collected south of Karamudli, 29-6-17, flowered at Kew, 5-7-18, *Turrill* (seed-number), 63.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Trifolium scabrum, *L.*
Foothills near Turica, small whitish corollas, large green calyces, 7-5-17, *Turrill,* 186.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Trifolium subterraneum, *L.*

Foothills near Turica, flowers and fruit, 24-5-17, *Turrill*, 297.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: Greece, Maced., Alb., Mtn., Bulg., Thrace.

Although this species is well-known, being, indeed, a British plant, the following observations, carefully made from very fine material in the field, may not be superfluous. The stems are prostrate, up to 1 ft. in length and closely applied to the ground. The whole plant is very hairy. The flower-heads are borne singly in the axils of the leaves, every leaf having an inflorescence in its axil except the lower ones, whose buds give rise to the branches. About 4 erect flowers comprise the young inflorescence—in every inflorescence seen there were 4 perfect flowers. In the centre of each head is a terminal bud. At or immediately after fertilization the 4 flowers spread out. The corolla is inconspicuous, whitish-yellow in colour, tinged with pink. The calyces have 5 long acicular teeth bearing long, distinct hairs. Soon after fertilization the calyces become swollen and bend downwards, exposing the terminal bud which commences to develop and produces numerous sterile flowers, each of which, when fully formed, is composed of a calyx tube with 5 long, acicular, spreading, hairy teeth. These sterile calyces bend over in succession and finally closely envelop the developing fruits. Each fruit contains a single seed. Meanwhile the common peduncle has lengthened and most of the fruit-heads get pushed below the loose surface of the soil. The sterile calyces of those thus buried are white and etiolated, of those remaining above ground pale green. The sterile calyx tubes are practically solid and their teeth become hardened into stiff bristles. Eventually the entire heads become detached.

Trifolium fragiferum, *L.*

Near Snevce, side of R. Spanc, in flower and fruit, 24-7-17, *Turrill*, 539.

Distr. Eur., N. Afr., Orient.

Balkans: General.

The swollen fruiting-calyces are somewhat more hairy than in the majority of specimens of this species in Herb. Kew.

Trifolium resupinatum, *L.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 114; Paprat District, Krusa Balkan, in flower and fruit, 6-18, *Russell*, 91; 8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 47; near Kopriva, in fruit, 29-5-17, *Turrill*, 349a.

Distr. S. Eur., Orient.

Trifolium hybridum, *L.*

By the side of the R. Spanc, near Snevce, white or pink-white flowers, 24-7-17, *Turrill*, 538.

Distr. Cent. and S. Eur., Orient.

Balkans: General.

Trifolium procumbens, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 52; seeds collected near Kopriva, 22-5-17, flowered at Kew, 6-6-18; *Turrill* (seed-number), 31; near Snevce, in flower, 24-7-17, a form with smaller leaves and flowers than in the typical plants, *Turrill*, 540.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Hymenocarpos circinnata, *Savi.*
8-10 km. north of Salonika, large terminal leaflets with yellow flowers, 13-4-17, *Turrill*, 16.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Thrace.

Dorycnium intermedium, *Led.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 156; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 66; foothills between Turica and Kopriva, white flowers, 17-5-17, *Turrill*, 254.
Distr. S.-E. Eur., Asia Minor.
Balkans: General.

Lotus corniculatus, *L.*, var. **pilosus,** *Jord.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 32.
Distr. Eur., Temp. Asia, etc.
Balkans: General.

Lotus angustissimus, *L.*
South-east of Karamudli, yellow flowers, 6-17, *Turrill*, 421; nullahs to south of Karamudli, 29-6-17, *Turrill*, 452a.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg.

Lotus aegeus, *Boiss.*
Struma Plain and Krusa Balkan, in flower, 4 to 6-18, *Harris*, 3, 211, 330; Uladaja Ravine, 2 miles south-west of Lake Doiran, very common, in flower, 12-6-17, *Baker*, 1; hill-slopes south-west of Turica, 5-5-17, *Turrill*, 157; between Turica and Kopriva, 16-5-17, *Turrill*, 246.
Distr. Thessaly, Maced., Thrace.
This is a very beautiful plant, about 1 ft. in height with large yellow flowers and grey-green stems and foliage covered with long, soft hairs.

Scorpiurus subvillosa, *L.*
8-10 km. north of Salonika, yellow flowers, 13-4-17, *Turrill*, 46.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece.

Ornithopus compressus, *L.*

8-10 km. north of Salonika, yellow flowers, 13-4-17, *Turrill*, 23; hill slopes south-west of Turica, in flower and fruit, 5-5-17, *Turrill*, 166; near Turica, in flower and fruit, 24-5-17, *Turrill*, 301.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

Coronilla emeroides, *Boiss.*

About 2 km. south-east of Orljak, Struma Plain, shrub with yellow flowers, 20-4-17, *Turrill*, 92a.

Distr. S.-E. Eur., Orient.

Balkans: General.

Coronilla varia, *L.*

3 km. south of Kocan mah, Krusa Balkan, in flower, 12-6-17, *Turrill*, 407.

Distr. Cent. and S. Eur., Orient.

Balkans: Greece, Maced., Mtn., Herz., Serb., Bulg.

Colutea arborescens, *L.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 240; about 3 km. south-east of Orljak, Struma Plain, shrub with yellow flowers, 20-4-17, *Turrill*, 92; near Turica, flowers and fruit, 24-5-17, *Turrill*, 310.

Distr. Cent. and S. Eur., N. Afr.

Balkans: General.

The *Colutea arborescens* of Velenovsky (Fl. Bulg., 147) is, in the writer's opinion, merely a form of *C. arborescens*, L. All the characters mentioned as distinguishing these two species are independently variable, *e.g.*, the number of pairs of leaflets, the indumentum and dentition of the calyx and the presence or absence of a tooth on the wings.

Arthrolobium scorpioides, *DC.*

Struma Plain and Krusa Balkan, 5-18, *Harris*, 70; 8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 26; foothills between Turica and Kopriva, in fruit, 4-6-17, *Turrill*, 372.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

Hippocrepis ciliata, *Willd.*

Foothills near Turica, in fruit, 24-5-17, *Turrill*, 296; seeds collected near Turica, 26-5-17, flowered at Kew, 5-7-18, *Turrill*, (seed-number), 18.

Distr. S. Eur., N. Afr., Orient.

Balkans: Greece, Maced., Herz.

Biserrula Pelecinus, *L.*

Struma Plain, about 2 km. south-east of Orljak, in flower, 27-4-17, *Turrill*, 109; foothills near Turica, in fruit, 24-5-17, *Turrill*, 305; seeds collected near Turica, 24-5-17, flowered at Kew, 5-7-18, *Turrill* (seed-number), 38.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: Greece.

Galega officinalis, *L.*
Krusa Balkan, in flower, 6-18, *Harris*, 390; side of R. Spanc, south of Snevce, in flower, 17-7-17, *Turrill*, 519.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Glycyrrhiza echinata, *L.*
Krusa Balkan, 6-18, *Harris*, 376 (in flower), 394 (in fruit).
Distr. Italy, S.-E. Eur., Orient.
Balkans: Greece, Maced., Bulg.

Astragalus chlorocarpus, *Griseb.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 157; Struma Plain and Krusa Balkan, in flower, 4 & 5-18, a form with smaller flowers and apparently white corollas, *Harris*, 158; Struma Plain, near Ormanli, coll. Staff-Sergt. Firth, 3-5-17, *Turrill*, 148; foothills near Turica, in flower, 12-5-17, *Turrill*, 201.
Distr. S.-E. Eur.
Balkans: Maced., Bulg., Thrace.

Astragalus hamosus, *L.*
Between Turica and Kopriva, white flowers, 30-4-17, *Turrill*, 123.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Mtn., Serb., Bulg., Thrace.

Astragalus sesameus, *L.*
8-10 km. north of Salonika, 13-4-17, *Turrill*, 10.
Distr. S. Eur., N. Afr.
Balkans: Greece (one specimen in Herb. Kew., not in Halácsy), Mtn.

Astragalus Sprunneri, *Boiss.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 135.
Distr. Greece, Maced., Mtn., Bulg.

Onobrychis alba, *Desv.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 159, 160.
Distr. S.-E. Eur.
Balkans: General.

Onobrychis gracilis, *Bess.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 141; foothills east of Turica, in flower and fruit, 27-5-17, *Turrill*, 338; seeds collected near Turica, 27-5-17, flowered and fruited at Kew, 25-6-18, *Turrill* (seed-number), 37.
Distr. S.-E. Eur.
Balkans: Maced., Bulg., Thrace.

Cicer arietinum, *L.*
East of Karamudli, in flower, 9-7-17, *Turrill*, 481.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece.

Pisum arvense, *L.*

Struma Plain, about 2 km. east of Orljak, in flower, 26-4-17, *Turrill*, 106; Struma Plain, coll. Staff-Sergt. Firth, in flower, 1-5-17, *Turrill*, 137.

Distr. Eur., N. Afr., Orient.

Balkans: General.

The buds have white standards, in the mature flowers the standards are pink and the wings dark-red.

Pisum elatius, *Stev.*

Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 262, 383.

Distr. Eur., N. Afr., Orient.

Balkans: Greece and probably general.

Lathyrus Aphaca, *L.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 161; 8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 38.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: General.

Lathyrus Nissolia, *L.*

Struma Plain and Krusa Balkan, in flower and young fruit, 5-18, *Harris*, 304; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 18; hills west by south of Kopriva, red flowers, 15-5-17, *Turrill*, 234.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: General.

Lathyrus tuberosus, *L.*

Gugunci, near the old church, in flower, 26-6-17, *Baker*, 23.

Distr. Eur., N. Afr., Orient, Temp. Asia.

Balkan: Maced., Mtn., Serb., Bulg.

Lathyrus sphaericus, *Retz.*

Seeds collected on the hills north of Karamudli, 18-6-17, flowered at Kew, 6-6-18, *Turrill* (seed-number), 48.

Distr. Cent. and S. Eur., Transcauc.

Balkans: Greece, Bulg.

Lathyrus annuus, *L.*

Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 88; Struma Plain, about 2 km. east of Orljak, yellow-brown flowers, 26-4-17, *Turrill*, 100; Struma Plain, between Kopriva and Kopriva Bridge, blue flowers, 26-5-17, *Turrill*, 325.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

Lathyrus Cicera, *L.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 21; near Gumus Dere, in flower, 4-18, *Russell*, 8; 8-10 km. north of Salonika, carmine flowers, 13-4-17, *Turrill*, 40; 6 km. north-east of Lahana, small flowers, 19-4-17, *Turrill*, 56; foothills between Turica and Kopriva, in flower, 30-4-17, *Turrill*, 122.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: General.

Lathyrus sativus, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris,* 231.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Lathyrus Ochrus, *DC.*
Kopriva, in flower, 30-4-17, *Turrill,* 131.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece.

Orobus hirsutus, *L.*
Struma Plain and Krusa Balkan, in flower, 4 to 6-18, *Harris,* 90, 196, 402; Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 86; 6 km. north-east of Lahana, in flower, 19-4-17, *Turrill,* 57.
Distr. S.-E. Eur., Orient, Caucasus.
Balkans: General.

Orobus hirsutus, *L.*, var. **glabratus,** *Griseb.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 196a; Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 94.
Distr. As type.

Orobus niger, *L.*
South-east of Karamudli, southern slopes of Krusa Balkan, purple flowers, 20-8-17, *Turrill,* 420.
Distr. Eur., Orient.
Balkans: General.

Orobus variegatus, *Ten.*
6 km. north-east of Lahana, hill country, in flower, 19-4-17, *Turrill,* 61.
Distr. S.-E. Eur., Asia Minor.
Balkans: General.

Orobus atropurpureus, *Desf.*
8-10 km. north of Salonika, simple racemes of purple flowers, 13-4-17, *Turrill,* 39.
Distr. S. Italy, Sicily, N. Afr.
The distribution of this plant is peculiar. It is not uncommon north of Salonika.

Vicia striata, *Bieb.*
Struma Plain, about 3 km. east of Orljak, clusters of blue-pink flowers, 20-4-17, *Turrill,* 79; about 2 km. south-east of Orljak, 27-4-17, *Turrill,* 108; Struma Plain, between Kopriva and Kopriva Bridge, in flower and fruit, 26-5-17, *Turrill,* 377; seeds collected near Turica, 9-6-17, flowered at Kew, 5-6-18, *Turrill* (seed-number), 45.
Distr. S. Eur.
Balkans: General.

Vicia peregrina, *L.*

Between Turica and Kopriva, blue and white solitary flowers, and hairy fruits, 2-5-17, *Turrill,* 139.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

Vicia grandiflora, *Scop.*

8-10 km. north of Salonika, large white flowers, 13-4-17, *Turrill,* 41; seeds collected near Mirova, 9-6-17, flowered at Kew, 5-6-18, *Turrill* (seed-number), 46.

Distr. S.-E. Eur., Orient.

Balkans: General.

Vicia grandiflora, *Scop.*, var. **sordida,** *Griseb.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 294.

Distr. S.-E. Eur., Asia Minor.

Balkans: General.

Vicia grandiflora, *Scop.*, var. **sordida,** *Griseb.*, mutant **dissecta,** *Turrill.*

Seed collected near Karamudli, 26-6-17, flowered at Kew, 5-6-18, *Turrill* (seed-number), 57.

Both typical *Vicia grandiflora,* Scop., and the variety *sordida* are abundant in Macedonia. The latter is distinguished by its narrower leaflets. Both the type and the variety vary in the colour of the flowers from a lemon-yellow to white, more or less shaded and streaked with dull violet. Three forms of the species are given by Beck (in Reichb., Ic. Fl. Germ., xxii. p. 187), whose views seem most acceptable, viz.:—

α *typica.* With nearly or quite rounded leaflets.

β *sordida.* With the leaflets mostly oblong or linear-oblong.

γ *Biebersteinii.* With the leaflets narrowly linear and 10-12 times as long as broad.

Seeds of both α and β were collected in Macedonia in 1917, and plants grown from them flowered at Kew in June, 1918. The plants of the var. *sordida* had many of the leaflets variously and conspicuously incised, yet to the best of my recollection the parent plant had the leaflets quite entire.

The records of the appearance of forms with divided leaflets of *V. grandiflora* and of its ally *V. Barbazitae* indicate that this variation is uncommon and sporadic. There is no specimen showing it at Kew or the British Museum.

In Boissier's Flora Orientalis, II., 573, *V. sordida,* W.K., is considered synonymous with *V. grandiflora,* Scop., and under this latter a variety γ *dissecta* is described as follows: "Foliola foliorum inferiorum profunde incisa," and is given as having its habitat "in sylvaticis montis Mesogis Cariae supra Tralles." This is almost certainly our plant. Boissier also describes (l.c. p. 574), a variety of *V. Barbazitae,* Ten. et Guss., with divided leaflets, var. *incisa,* Boiss., "Foliola praesertim inferiora profunde et obtuse dentata. *V. Thessala,* Sprun. pl. exs. *V. incisa,* Orph. exs. non. M.B." The habitat is given as "in monte Malevo Laconiae (Orph. Fl. Gr. exs. 594!), in monte Œta Thessaliae (Sprun!) Fl. Jun." The species *V. Bar-*

bazitae is distinguished from *V. grandiflora* by its smaller corolla, with distinctly violet wings, its longer calyx-teeth, and its larger seeds which have a short hilum.

In Oesterr. Bot. Zeitschr., 1873, p. 80, Pantocsek described a species of *Vicia* with divided leaflets, naming it *V. serrata*, Pant. He distinguishes it from *V. grandiflora*, Scop., with its var. *dissecta*, Boiss., and from *V. Barbazitae*, Ten. et Guss., with its var. *incisa*, Boiss., by all the leaflets being deeply serrated, by the colour of the corrollas "vexillo . . . . sordide bruneo-flavo, basin cum tinctu coeruleo-purpurascente; alis flavis, carina flava, apice atra," and by its longer peduncle, yet he considers it intermediate between the two species. The habitat is given as "inter dumetos montis Gliva prope Trebinje (Hercegovina) Mai."

Rohlena (Sitzb. Bohm. Ges. Wiss., 1904, p. 43 (1905), reduces *V. serrata*, Pant. to a variety of *V. grandiflora*, Scop., having collected a plant in Montenegro which he believed to be the same as Pantocsek's. This last author states the corolla of his *V. serrata* to be 14 mm. in length; Rohlena says most of the corollas of his specimens are 20 mm. in length but that smaller ones occur. Ascherson and Graebner, Syn. Fl. Mit. Eur., vi., Abth. 2, p. 952, writing with specimens collected by Rohlena before them, state the corollas to be 2·5 cm. in length. It seems probable that Rohlena's examples belong to *V. grandiflora*, Scop., var. *dissecta*, Boiss., and that *V. serrata*, Pant. is a form of *V. Barbazitae*, Ten. et Guss., though probably not the var. *incisa*, Boiss., which has much longer calyx teeth.

It is evident that in this group of Vicias a tendency towards developing incised leaflets exists and sporadically reveals itself. Whether or not hybridization or external conditions can influence the appearance of the incised forms we do not know.

Vicia sativa, L., has also a sporadically appearing variety with incised leaflets, recorded from Italy, Sicily, Crimea and Caucasus. *V. sativa* γ *incisa*, Boiss., Fl. Or. ii., 574 (1872). *V. incisa*, M. Bieb., Fl. Taur.-Cauc. III., 171 (1819). *V. pimpinelloides*, Maur., Pl. Rom., 35, t. 1.

Vicia melanops, *S. et S.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 108; Struma Plain, about 3 km. east of Orljak, flowers yellow and yellow-brown, 20-4-17, *Turrill*, 85.

Distr. S.-E. Eur.

Balkans: General.

Vicia sativa, *L.*

8-10 km. north of Salonika, in flower and fruit, 13-4-17, *Turrill*, 24.

Distr. Eur., N. Afr., Orient.

Balkans: General.

Vicia sativa, *L.* subsp. **notata,** *Aschers. et Graeb.*

Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 92.

Distr. Eur., N. Afr., W. Asia.

Balkans: General.

Vicia angustifolia, *Roth.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris,* 181, 182; seeds collected on the hills west of Karamudli, 30-6-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 67.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Vicia lathyroides, *L.*
8-10 km. north of Salonika, in flower and fruit, 13-4-17, *Turrill,* 30.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Serb., Bulg., Thrace.

Vicia narbonensis, *L.*
Struma Plain, about 3 km. south-east of Orljak, in flower and fruit, 20-4-17, *Turrill,* 84; seeds collected near Turica, 28-5-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 14.
Distr. S. Eur. N. Afr., Orient.
Balkans: Greece, Alb., Bulg., Thrace.

Vicia serratifolia, *Jacq.*
Struma Plain, about 3 km. east of Orljak, in flower, 20-4-17, *Turrill,* 87.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Vicia cassubica, *L.*
West of Karamudli, in fruit, 16-7-17, *Turrill,* 514.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Vicia bithynica, *L.*
Struma Plain, about 2 km. east of Orljak, blue flowers, 26-4-17, *Turrill,* 98; Struma Plain, between Kopriva and Kopriva Bridge, in flower, 26-5-17, *Turrill,* 324.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Thrace.

Vicia tenuifolia, *Roth.*
Between Turica and Kopriva, a very fine plant, in flower, 2-5-17, *Turrill,* 142.
Distr. Eur., Orient, N. Asia.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Vicia tenuifolia, *Roth.,* var. **stenophylla,** *Boiss.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 27.
Distr. (of var.) S.-E. Eur., Orient.
Balkans: As species.

Vicia villosa, *Roth.*
Seeds collected south of Karamudli, 29-6-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 64.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Ervum hirsutum, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 144; 8-10 km. north of Salonika, in flower and fruit, 13-4-17, *Turrill*, 49.
Distr. Eur., Asia.
Balkans: General.

Ervum tetraspermum, *L.*
Paprat District, Krusa Balkan, in flower and fruit, 6-18, *Russell*, 17.
Distr. Cent. and S. Eur., Orient, Temp. Asia.
Balkans: General.

Lens nigricans, *Godr.*
8-10 km. north of Salonika, small pale-blue flowers, 13-4-17, *Turrill*, 14; seeds collected on the southern slopes of the Krusa Balkan, north of Karamudli, 18-6-17, flowered at Kew, 3-7-18, *Turrill* (seed-number), 50.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

ROSACEAE.

Amygdalus communis, *L.*
Commonly cultivated in Macedonia, 10 km. north of Salonika, in flower, 5-2-17, *Turrill*.
Distr. Orient.
Balkans: Introduced.

Prunus divaricata, *Ledb.*
Near Gumus Dere, in flower, 4-18, *Russell*, 15.
Distr. S.-E. Eur., Orient.
Balkans: Maced., Thrace, Bulg.

Pyrus amygdaliformis, *Vill.*
South of Karamudli, in fruit, 13-7-17, *Turrill*, 489.
Distr. S.-E. Eur., Orient.
Balkans: General.
A form with long, narrow leaves with cuneate bases.

***Rubus tomentosus,** *Borkh.*
Nullahs to south of Karamudli, in flower, 29-6-17, *Turrill*, 452.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

***Rubus collinus,** *DC.*
Between Turica and Kopriva, in flower, 24-5-17. *Turrill*, 304.
Distr. S. Eur.
Balkans: Not previously recorded.
White flowers with scent like flowers of hawthorn.

***Rubus anatolicus,** *Focke.*
Southern slopes of Krusa Balkan, north of Karamudli, in flower, 29-6-17, *Turrill*, 450.
Distr. Greece and Orient.

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* Determined by R. A. Rolfe.

Fragaria viridis, *Duchsne.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 220.
Distr. Eur., Orient.
Balkans: General.

Potentilla hirta, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 250; foothills between Turica and Kopriva, in flower, 2-5-17, *Turrill,* 140.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Potentilla recta, *L.*
Struma Plain and Krusa Balkan, in flower, 4 to 6-18, *Harris,* 39, 251, 353.
Distr. Cent. and S. Eur., Orient, Temp. Asia.
Balkans: General.

Potentilla argentea, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 56; hills west by south of Kopriva, small yellow flowers, 15-5-17, *Turrill,* 237.
Distr. Eur., Orient.
Balkans: General.
Strong perennial stock.

Potentilla reptans, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 57; Struma Plain, between Kopriva and Kopriva Bridge, in damp ground, yellow flowers, 26-5-17, *Turrill,* 328.
Distr. Eur., N. Afr., Orient, etc.
Balkans: General.

Geum urbanum, *L.*
Krusa Balkan, in flower and fruit, 6-18, *Harris,* 344.
Distr. Eur., Orient, N. Afr., Temp. Asia.
Balkans: General.
The deciduous portions of the styles in the young fruits are decidedly more hairy than usual.

***Rosa gallica,** *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 295; Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 28; hills west by south of Kopriva, in flower, 15-5-17, *Turrill,* 236.
Distr. Cent. and S. Eur.
Balkans: Greece, Maced., Mtn., Serb.. Bulg.
Whole plant less than 1 ft. high, growing round the outside of bush clumps. Flowers large, pink, with a very sweet scent.

***Rosa foetida,** *Herrm.* (*R. lutea.,* Mill.)
Turica, probably planted, bright yellow flowers with strong unpleasant smell, 1-6-17, *Turrill,* 358.
Distr. Asia Minor to India.

* Determined by R. A. Rolfe.

*__Rosa micrantha,__ *Smith.*

Near Turica, abundant on the foothills, a very sweetly scented briar, in flower, 28-5-17, *Turrill*, 346.

Distr. Cent. and W. Eur., Orient.

Balkans: Greece.

The petals are white and 5 to each flower, but there is a strong tendency for 1, 2 or 3 of these to be reduced in size and narrowed. They then develop yellow margins—probably with a tendency to produce pollen. These abnormal petals are most often 2 close together and they are the first to fade and fall off. Very few indeed, of the flowers have 5 perfectly normal petals.

Agrimonia odorata, *Mill.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 270; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 81; southern slopes of Krusa Balkan, west of Karamudli, in flower, 21-6-17, *Turrill*, 433.

Distr. Eur., N. Afr., Orient.

Balkans: General.

Agrimonia agrimonioides, *L.*

6 km. north-east of Lahana, in flower, 19-4-17, *Turrill*, 64.

Distr. S.-E. Eur., Orient.

Balkans: General.

Spiraea Filipendula, *L.*

Krusa Balkan, in flower, 6-18, *Harris*, 343; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 25; Gugunci, common on the hill-side, in flower, 15-5-17, *Baker*, 4.

Distr. Eur., Orient, Temp. Asia.

Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

ONAGRACEAE.

Epilobium parviflorum, *Schreb.*

South-east of Karamudli, pink flowers, 20-6-17, *Turrill*, 427; nullahs south of Karamudli, pink flowers, 15-7-17, *Turrill*, 498.

Distr. Eur., N. Afr., Orient.

Balkans: General.

LYTHRACEAE.

Lythrum Salicaria, *L.*

Krusa Balkan, in flower, 6-18, *Harris*, 385; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 68; southern slopes of Krusa Balkan, west of Karamudli, in flower, 4-7-17, *Turrill*, 474.

Distr. Eur., N. Afr., Orient, Temp. Asia, N. Amer., etc.

Balkans: General.

Lythrum virgatum, *L.*

Krusa Balkan, in flower, 6-18, *Harris*, 386.

Distr. E. and S.-E. Eur., Orient, N. Asia.

Balkans: General from Thessaly northwards.

* Determined by R. Rolfe.

TAMARISCINEAE.

Tamarix tetrandra, *Pall.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 16; Struma Plain, about 3 km. east of Orljak, in flower, 20-4-17, *Turrill*, 86.

Distr. Greece, Maced., Thrace, Orient.

PORTULACACEAE.

Portulaca oleracea, *L.*

Side of R. Spanc, near Snevce, yellow flowers, 17-7-17, *Turrill*, 518.

Distr. Temp. and warm parts of whole world.

Balkans: General.

PUNICACEAE.

Punica Granatum, *L.*

Cultivated at Turica, scarlet flowers, 1-6-17, *Turrill*, 359.

Distr. S.-E. Eur., Orient.

Balkans: Greece, Maced., Thrace.

PARONYCHIACEAE.

Polycarpon tetraphyllum, *L.*

Foothills near Turica, in flower, 24-5-17, *Turrill*, 307.

Distr. Eur., introduced into most parts of the world.

Balkans: Greece, Maced., Mtn.

Herniaria glabra, *L.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 178.

Distr. Eur., Orient, Temp. Asia.

Balkans: General.

Herniaria cinerea, *DC.*

Struma Plain, about 3 km. east of Orljak, in flower and fruit. 20-4-17, *Turrill*, 90.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

SCLERANTHACEAE.

Scleranthus perennis, *L.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 201; Paprat District, Krusa Balkan, in flower and fruit, 6-18, *Russell*, 69; south of Kocan mah, east Krusa Balkan, in flower, 12-6-17, *Turrill*, 408.

Distr. Eur.

Balkans: General.

Scleranthus verticillatus, *Tausch.*

8-10 km. north of Salonika, 13-4-17, *Turrill*, 25.

Distr. S. and Cent. Eur., Orient,

Balkans: General.

CRASSULACEAE.

Umbilicus pendulinus, *DC.*
On rocks in foothills, south-west of Turica, 30-5-17, *Turrill,* 356.
Distr. W. and S. Eur., N. Afr., Asia Minor.
Balkans: Greece, Maced., Mtn., Thrace.

Sedum Cepaea, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 179, 180; rocky slopes near Trinity Well, south-west of Turica, in flower, 7-5-17, *Turrill,* 398.
Distr. Cent. and S. Eur., Orient.
Balkans: General.
A rather small flowered form.

Sedum glaucum, *W. K.*
On rocks, hills between Turica and Gumus Dere, pinkish flowers, 5-6-17, *Turrill,* 378.
Distr. S. Eur., Orient.
Balkans: General.

Sedum rubens, *DC.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 274; rocky slopes of nullah near Trinity Well, south-west of Turica, in flower and fruit, 7-5-17, *Turrill,* 399.
Distr. S. Eur., N. Afr.
Balkans: Greece, Serb., Bulg.

Sedum caespitosum, *DC.*
Struma Plain and Krusa Balkan, in fruit, 4 & 5-18, *Harris,* 118.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Sedum tenuifolium, *S. et S.* (*S. amplexicaule,* DC.)
Krusa Balkan, in flower, 6-18, *Harris,* 342.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced.

SAXIFRAGACEAE.

Saxifraga chrysoplenifolia, *Boiss.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 112.
Distr. Greece.

Saxifraga graeca, *Boiss. et Heldr.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 120.
Distr. Greece, Maced., Mtn., Herz., Serb., Bulg.

Saxifraga graeca, *Boiss. et Heldr.* var. **Russellii,** *Turrill,* var. nov.
A planta typica inflorescentia ramosiore, floribus numerosioribus, petalis minoribus differt.
Near Gumus Dere, 5-18, *Russell,* 2.

Orlaya grandiflora, *Hoffm.*

Struma Plain and Krusa Balkan, in flower, 5-18 *Harris,* 324; foothills between Turica and Kopriva, in flower and fruit, 5-6-17, *Turrill,* 374.

Distr. Cent. and S. Eur., Orient.

Balkans: General.

White florets, external ones with large abaxial petals.

Orlaya platycarpos, *L.*

Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris,* 147; between Turica and Kopriva, white flowers, 18-5-17, *Turrill,* 263.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

Daucus setulosus, *Gaertn.*

Between Kasimli and Snevce, in flower and fruit, 1-7-17, *Turrill,* 464.

Distr. Italy, S.-E. Eur., Orient.

Balkans: General.

This species is very common west and south of Karamudli. The great florets in the compound umbel have their petals, stamens and styles cream-white in colour, but often a few of the central florets have these parts wallflower-red in colour. Rarely all the florets are cream-white. The deep red florets vary in number and distribution of colour. Sometimes 1, 2, 3 or 4 florets, always in the centre of the umbel, are entirely red. Often some of the florets are partially red, partially cream-white. For instance, two petals or even two contiguous half-petals and the stamens and style nearest these may be red while the rest of the floret is cream-white. The stamens and ovaries are equally developed in red and white florets, and both develop fruits.

Caucalis leptophylla, *L.*

Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris,* 140; foothills between Turica and Kopriva, white flowers and fruit, 18-5-17, *Turrill,* 262.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

Caucalis latifolia, *L.*

Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris,* 67.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: Greece, Maced., Alb., Serb.

Tordylium maximum, *L.*

Southern slopes of Krusa Balkan, near Karamudli, in flower and fruit, 26-6-17, *Turrill,* 442.

Distr. Cent. and S. Eur., Orient.

Balkans: General.

Tordylium officinale, *L.*
Gugunci, Jeniköj and Uladaja Ravine, in flower, 4-5-17, *Baker*, 25.
Distr. Italy, S.-E. Eur.
Balkans: Greece, Maced., Mtn., Thrace.

Oenanthe media, *Griseb.*
Struma Plain and Krusa Balkan, in flower and young fruit, 4 & 5-18, *Harris*, 148, 241.
Distr. S.-E. Eur., Orient.
Balkans: General from Macedonia northwards.

Anthriscus vulgaris, *Pers.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 50.
Distr. Eur., Orient, N. Afr.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Scandix Pecten-Veneris, *L.*
8-10 km. north of Salonika, in flower and fruit, 13-4-17, *Turrill*, 28; seed collected near Turica, 12-5-17, flowered at Kew, 25-5-18, *Turrill* (seed-number), 23.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Bunium Bulbocastanum, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 26.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.

Bupleurum apiculatum, *Friv.*
Near Trinity Well, south-west of Turica, in flower, 7-6-17, *Turrill*, 397.
Distr. Greece, Maced., Serb., Bulg.

Bupleurum laxum, *Vel.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 171; southern slopes of Krusa Balkan, west of Karamudli, flowers and young fruits, 16-7-17, *Turrill*, 512.
Distr. Maced., Serb., Bulg.
Yellow flowers, grass-like leaves.

Conium maculatum, *L.*
Struma Plain, near Ormanli, 20-5-17, *Turrill*, 277.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.
This plant grows luxuriantly in the hot plain, reaching a height of 10 ft., and the huge, thick stems are used by troops to support their "bivies."

Smyrnium perfoliatum, *L.*
Struma Plain and Krusa Balkan, in flower, 4 to 6-18, *Harris*, 66, 348.
Distr. S. Eur. Orient.
Balkans: Greece, Maced., Mtn., Serb., Alb., Bulg.

Bifora testiculata, *DC.*
Struma Plain, about 3 km. east of Orljak, in flower and fruit, 23-4-17, *Turrill*, 95.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.

Eryngium campestre, *L.*
Near Snevce, blue flowers, 25-7-17, *Turrill*, 533.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

CORNACEAE.

Cornus sanguinea, *L.*
Foothills between Turica and Kopriva, in flower, 7-5-17, *Turrill*, 180.
Distr. Cent. and S. Eur., N. Asia.
Balkans: General.

CAPRIFOLIACEAE.

Sambucus Ebulus, *L.*
Uladaja Ravine, Kilindir and "Deep-cut" Ravine, near water-side, in flower, 12-6-17, *Baker*, 17; nullahs to south of Karamudli, strong pleasant smell to flowers, 15-7-17, *Turrill*, 502.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Lonicera Caprifolium, *L.*
Hills between Turica and Gumus Dere, in flower and fruit, 5-6-17, *Turrill*, 376.
Distr. W., Cent. and S. Eur., Orient.
Balkans: General.
A form with green flowers.

Lonicera etrusca, *Santi.*
Near Turica, in flower, 15-5-17, *Turrill*, 211.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn.

RUBIACEAE.

Galium Mollugo, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 99, 233.
Distr. Eur., Orient.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.
A form with stem and leaves densely puberulous.

Galium palustre, *L.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 289, 357; at side of pool between Kasimli and Snevce, white flowers, 1-7-17, *Turrill*, 458.
Distr. Eur., N. Afr.
Orient: Alb., Serb., Bulg., Thrace.

Galium verum, *L.*
Struma Plain and Krusa Balkan, in flower, 6 & 7-18, *Harris*, 341, 387; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 53; Kilindir, Jeniköj and Gugunci, in flower, 18-6-17, *Baker*, 10; near Karamudli, southern slopes of Krusa Balkan, yellow flowers, 28-6-17, *Turrill*, 444.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Galium tricorne, *With.*
Struma Plain and Krusa Balkan, in flower and young fruit, 4 & 5-18, *Harris*, 83.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Galium Cruciata, *Scop.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 119, 267.
Distr. Eur., Temp. Asia.
Balkans: General.

Galium parisiense, *L.*, var. **leiocarpum,** *Tausch.*
Near Trinity Well, south-west of Turica, in fruit, *Turrill*, 401.
Distr. Eur., N. Afr., Orient.
Balkans: Thrace.

Galium laconicum, *Boiss. et Heldr.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 82; southern slopes of Krusa Balkan, near Karamudli, amongst bushes, white flowers, 26-6-17, *Turrill*, 443.
Distr. Greece.
The leaves are somewhat narrower than in the typical plant which is recorded from Epirus and Thessaly as well as from southern Greece.

Asperula arvensis, *L.*
Hills west by south of Kopriva, blue flowers and fruit, 15-5-17, *Turrill*, 231.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Crucianella graeca, *Boiss.*
Near Baisili, top of Krusa Balkan, amongst the herbage on the stony slopes, in flower, 24-6-17, *Turrill*, 438; near Baisili, 14-7-17, *Turrill*, 493.
Distr. S.-E. Eur., Asia Minor.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

VALERIANACEAE.

Valerianella olitoria, *L.*
Near the well, Turica, in fruit, 25-5-17, *Turrill*, 314.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Serb., Bulg.

Valerianella membranacea, *Lois.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 219; 8-10 km. north of Salonika, in flower and young fruit, 13-4-17, *Turrill,* 48; seeds collected between Turica and Kopriva, 9-5-17, flowered at Kew, 4-6-18, *Turrill* (seed-number), 32.

Distr. S. Eur., Orient.

Balkans: General.

The upper leaves, excepting the one or two top pairs, are bifid or trifid with the lateral segments smaller.

Dipsaceae.

Scabiosa ucranica, *L.*

Struma Plain and Krusa Balkan, in flower, 6-18, *Harris,* 324; Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 41; nullahs to south of Karamudli, white flowers, 15-7-17, *Turrill,* 503.

Distr. S. Eur., Orient.

Balkans: General.

Scabiosa sicula, *L.*

Foothills near Turica, in flower and fruit, 24-5-17, *Turrill,* 309.

Distr. Spain, Sicily, Crete, Thrace, Orient.

Callistemma palaestinum, *L.*

Foothills south-west of Turica, blue flowers, 30-5-17, *Turrill,* 354.

Distr. S.-E. Eur., Orient.

Balkans: Greece, Maced., Thrace.

Knautia orientalis, *L.*

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 7, 247; hill-slopes between Gumus Dere and Turica, in flower, 15-5-17, *Turrill,* 212.

Distr. Maced., Bulg., Thrace, Asia Minor.

The red florets are aggregated in small numbers in capitula. Most often only the ray type of floret is present. These have irregular corollas with 4 petals each. The abaxial petal is the largest and is broadly oblanceolate; the two lateral petals are shorter, smaller and lanceolate; the adaxial one is reduced to a mere white tooth one-third the size of the lateral petals. In larger heads, however, disc florets occur. These are almost regular and their corollas have each 4 equal teeth of the size, shape and colour of the adaxial tooth of the corolla in the ray florets. Transitions between the ray and disc florets were observed and in these the abaxial and lateral corolla teeth were less reduced than in the true disc florets.

Knautia hybrida, *Coult.*

Struma Plain, near Kopriva, blue flowers, 30-5-17, *Turrill,* 355.

Distr. S. Eur., N. Afr., Orient.

Balkans: General.

Knautia macedonica, *Griseb.*, subsp. **lyrophylla,** *Vel.* (*Panč.*)

Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 269; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 23.

Distr. Maced., Herz., Bosnia, Serb., Bulg.

COMPOSITAE.

Doronicum caucasicum, *M. B.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 259.

Distr. S.-E. Eur., Orient.

Balkans: General.

Senecio vernalis, *W. K.*

Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris*, 258.

Distr. Cent. and S.-E. Eur., N. Afr., Orient.

Balkans: General.

Anthemis tinctoria, *L.*

Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 208, 315, 325, 360; foothills between Turica and Kopriva, orange flowers, 18-5-17, *Turrill*, 261a.

Distr. Eur., Orient, N. Asia.

Balkans: General.

Anthemis Cota, *L.*

Kopriva, large heads, distinct scent, in flower, 4-6-17, *Turrill*, 366.

Distr. S. Eur., Orient.

Balkans: Greece, Maced., Bulg.

Anthemis arvensis, *L.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 54, 139, 217.

Distr. Eur., N. Afr., Orient.

Balkans: General.

Anthemis Cotula, *L.*

Kopriva, very strong scent, in flower, 4-6-17, *Turrill*, 367.

Distr. Eur., N. Afr., Orient, Temp. Asia.

Balkans: General.

Achillea Millefolium, *L.*

Near Snevce, pale pink flowers, 24-7-17, *Turrill*, 541.

Distr. Eur., Orient, N. and Cent. Asia, N. Amer.

Balkans: Maced., Serb., Bulg.

Achillea crithmifolia, *W. K.*

Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 249, 256; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 54; foothills to south of Kopriva, strong scent, dirty-white flowers, 30-5-17, *Turrill*, 357; south-east of Karamudli, 20-6-17, *Turrill*, 431.

Distr. S.-E. Eur.

Balkans: General.

Achillea clypeolata, *S. et S.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 89, 275; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 76; hills west by south of Kopriva, yellow flowers, 15-5-17, *Turrill* 232.
Distr. N. Greece, Maced., Serb., Bulg., Thrace.

Matricaria Chamomilla, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 138.
Distr. Eur., Orient, Temp. Asia.
Balkans: General.

Chrysanthemum segetum, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 105; Struma Plain, about 2 km. east of Orljak, yellow flowers, 23-4-17, *Turrill*, 96.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.

Filago germanica, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 252; abundant in fields near Turica, in flower, 24-5-17, *Turrill*, 311.
Distr. Eur., Orient, N. Asia.
Balkans: General.

Filago arvensis, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 166; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 71; abundant in fields near Turica, in flower, 6-6-17, *Turrill*, 384.
Distr. Cent. and S. Eur., Orient, N. Asia.
Balkans: General.

Erigeron canadensis, *L.*
Struma Plain, between Kopriva and Kopriva Bridge, in flower, 26-5-17, *Turrill*, 326; nullahs to south of Karamudli, in flower, 15-7-17, *Turrill*, 497.
Distr. Eur., Orient, N. Amer.
Balkans: General.

Erigeron linifolius, *Willd.*
Struma Plain and Krusa Balkan, in fruit, 5-18, *Harris*, 323.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece.

Inula hirta, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 43.
Distr. Eur., Orient, Temp. Asia.
Balkans: General.

Inula salicina, *L.*
Southern slopes of Krusa Balkan, west of Karamudli, in flower, 21-6-17, *Turrill*, 435.
Distr. Eur., Orient, N. Asia.
Balkans: Alb., Bosnia, Mtn., Serb., Bulg., Thrace.

Inula germanica, *L.*
Krusa Balkan, in flower, 6-18, *Harris,* 363.
Distr. Cent. and S.-E. Eur., Orient.
Balkans: General from Thessaly northwards.

Inula britannica, *L.*
Krusa Balkan, in flower, 6-18, *Harris,* 388; southern slopes of Krusa Balkan, west of Karamudli, in flower, 7-7-17, *Turrill,* 477.
Distr. Cent. and S. Eur., Orient, N. Asia.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Asteriscus aquaticus, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 64; between Turica and Kopriva, yellow flowers, 2-6-17, *Turrill,* 363.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Thrace.

Helianthus annuus, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 185. An escape from cultivation. Native of N. America.

Echinops microcephalus, *S. et S.*
Southern slopes of Krusa Balkan, near Karamudli, blue heads of flowers, 10-7-17, *Turrill,* 508.
Distr. Balkans and Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Carlina lanata, *L.*
Sarigol, near Kukus, 8-17, *Turrill,* 544.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Alb.

Xeranthemum annuum, *L.*
Struma Plain and Krusa Balkan, 5 & 6-18, *Harris,* 191, 369; foothills south of Turica, pink flowers, 27-5-17, *Turrill,* 339.
Distr. S. Eur., Asia Minor, Caucasus.
Balkans: Greece, Maced., Serb., Thrace.

Xeranthemum cylindraceum, *S. et S.*
Southern slopes of Krusa Balkan, south-east of Karamudli, pink flowers, 20-8-16, *Turrill,* 428.
Distr. S. Eur., Orient.
Balkans: General.

Carduus hamulosus, *Ehrh.*
Hills west by south of Kopriva, 15-5-17, *Turrill,* 239.
Distr. S.-E. Eur., Orient.
Balkans: Greece, Serb., Bulg.

Carduus pycnocephalus, *L.*
Seed collected near Turica, 6-6-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 39.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Thrace.

Carduus pycnocephalus, *L.*, var. **cinereus,** *Boiss.*
Seeds collected between Turica and Kopriva, 30-5-17, flowered at Kew, 15-7-18, *Turrill* (seed-number), 22.
Distr. Caucasus, Transcaucasus.
This plant agrees well with the description given in Boissier, Flora Orientalis III., p. 521.

Silybum Marianum, *Gaertn.*
Seeds collected between Turica and Kopriva, 30-5-17, *Turrill* (seed-number), 33.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.
This is one of the commonest and most conspicuous of Macedonian plants. In the spring its rosettes of variegated green and white leaves are to be seen on the hills amongst *Quercus coccifera* bushes, in uncultivated places in the plains and on roadside banks. The flowering stems shoot up in March and April and may reach to 7 or 8 ft. in height. It was first found in flower in the Struma Plain, about 2 km. east of Orljak on 26-4-17.

Jurinea arachnoidea, *Bge.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 72, 239.
Distr. S.-E. Eur., Orient, Caucasus.
Balkans: Bulg.

Jurinea arachnoidea, *Bge.*, forma **integrifolia,** *Turrill.*
A forma typica foliis integris differt.
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 151.
Found occasionally with the type.

Carthamnus lanatus, *L.*
Foothills between Turica and Kopriva, yellow flowers, 2-6-17, *Turrill*, 361.
Distr. S. Eur., Orient.
Balkans: General.

Cnicus benedictus, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 86; hill-slopes south-west of Turica, yellow flowers, 5-5-17, *Turrill*, 164.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Bulg., Thrace.
Often grows in extensive clusters, $\frac{1}{2}$ to 2 feet in height.

Centaurea pullata, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 107.
Distr. Portugal, Spain, S. France, Egypt.
The writer has no explanation to offer of the unusual distribution of this plant, for not having collected it himself he is unable to say whether it is more likely to be a native or an alien.

Centaurea stenolepis, *Kerner.*
Western end of Krusa Balkan, overlooking Lake Doiran, in bud, 1-7-17, *Turrill,* 468.
Distr. Hungary, Mtn., Serb., Bulg.

Centaurea Cyanus, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 123, 277; on stony hill-slopes between Turica and Gumus Dere, blue and white flowers, 5-6-17, *Turrill,* 382.
Distr. Eur., Orient.
Balkans: General.
Velenovsky (Fl. Bulg., p. 308) considers this a native of Bulgaria. In Macedonia also it occurs "non solum in campis cultis inter segetes sed etiam in collinis graminosis saxosisque ad montes."

Centaurea salonitana, *Vis.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 34; west of Karamudli, large yellow heads, 16-7-17, *Turrill,* 509.
Distr. S.-E. Eur.
Balkans: General.

Centaurea solstitalis, *L.*
Between Kasimli and Snevce, yellow flowers, 1-7-17, *Turrill,* 461.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Centaurea Calcitrapa, *L.*
Near Karamudli, red flowers, 4-7-17, *Turrill,* 475.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Centaurea subianata, *Boiss.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell,* 39; Krusa Balkan, 6-18, *Harris,* 349; southern slopes of Krusa Balkan, north of Karamudli, red flowers, 29-6-17, *Turrill,* 451.
Distr. Maced., Bulg., Thrace.

Centaurea Scabiosa, *L.* var. **tenuiloba,** *Boiss.*
Between Mirova and Kurkut, Krusa Balkan, deep carmine flowers, 14-6-17, *Turrill,* 411.
Distr. Maced.
The following are synonyms of this variety, which is probably worth specific rank: *Centaurea atrofusca,* Janka, in Herb. Kew, ined.; *Centaurea atropurpurea,* Griseb., non W. K.; *Centaurea cuneifolia,* DC., var. *angustiloba,* DC.

Crupina vulgaris, *Cass.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris,* 14; near Kopriva, pink flowers, 10-5-17, *Turrill,* 191; Gumus Dere, in flower, 7-6-17, *Turrill,* 387.
Distr. S. Eur., Orient.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Sonchus asper, *Vill.*
Ravine between Turica and Kopriva, in flower and fruit, 29-5-17, *Turrill,* 348.
Distr. Cosmopolitan.
Balkans: General.

Lactuca Scariola, *L.*
Nullah south of Karamudli, in flower and fruit, 23-7-17, *Turrill,* 522.
Distr. Cent. and S. Eur., N. Afr., Orient, N. Asia.
Balkans: Greece, Serb., Bulg.
The broad leaves have a basal twist which makes them stand out edgeways from the stem.

Chondrilla juncea, *L.*
Krusa Balkan, in flower and fruit, 6-18, *Harris,* 395; southern slopes of Krusa Balkan, near Karamudli, in flower and fruit, 16-7-17, *Turrill,* 507.
Distr. Eur., Orient, N. Asia.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Taraxacum megalorrhizon, *Hand.-Maz.*
Near Akbunar, 9 km. north-west of Salonika, 10-17, *Turrill,* 550.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Tolpis umbellata, *Bert.*
Hills between Turica and Gumus Dere, in flower, 25-5-17, *Turrill,* 318.
Distr. S. Eur., Orient.
Balkans: Greece.
Outer florets pale yellow, inner florets darker brown-yellow.

Crepis setosa, *Hall.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris,* 254; near Kopriva, 15-5-17, *Turrill,* 242.
Distr. Cent. and S.-E. Eur., Orient.
Balkans: General.

Crepis neglecta, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris,* 53, 299; 8-10 km. north of Salonika, in flower and fruit, 13-4-17, *Turrill,* 21.
Distr. Italy, S.-E. Eur.
Balkans: Greece, Maced., Mtn., Herz., Thrace.

Hieracium Bauhini, *Schult.* (following the nomenclature of Velenovsky, Fl. Bulg., p. 340).
Foothills between Turica and Kopriva, long stolons, yellow heads, 25-5-17, *Turrill,* 313.
Distr. Eur., Asia Minor, Caucasus.
Balkans: General.

Hedypnois cretica, *L.*
Foothills near Turica, in fruit, 4-5-17, *Turrill*, 144; seed collected near Turica, 24-5-17, flowered at Kew, 1-6-18, *Turrill* (seed number), 20.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced.

Zacyntha verrucosa, *Gaertn.*
Between Turica and Kopriva, yellow flower-heads, 17-5-17, *Turrill*, 255.
Distr. S. Eur., Orient.
Balkans: General.

Tragopogon porrifolius, *L.*
Struma Plain, 3 km. east of Orljak, blue flowers, 20-4-17, *Turrill*, 93.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Tragopogon pratensis, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 to 6-18, *Harris*, 71, 332.
Distr. Eur., Orient, Temp. Asia.
Balkans: General.

Scorzonera laciniata, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 33, 192, 222; between Turica and Kopriva, yellow flowers, 2-5-17, *Turrill*, 141.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Hypochaeris radicata, *L.*
Near Kopriva in fruit, 15-5-17, *Turrill*, 241.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Hypochaeris glabra, *L.*
Seeds collected near Trinity Well, south-west of Turica, 7-6-17, flowered at Kew, 15-6-18, *Turrill* (seed-number), 42.
Distr. Eur., N. Afr., Orient.
Balkans: General.
This plant represents a form in which all the fruits have a sessile pappus, that is, the achenes have no beaks. This appears to be an inherited character, for it occurred in the parent and in all the plants raised in the first filial generation.

Scolymus hispanicus, *L.*
Near "Plane Tree Well," west of Karamudli, yellow flowers, 30-6-17, *Turrill*, 457.
Distr. S. Eur., Orient.
Balkans: General.

Cichorium Intybus, *L.*, var. **glabratum,** *Presl.*
Krusa Balkan, in flower, 6-18, *Harris*, 365; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 44.
Distr. S. Eur., Orient, Temp. Asia.
Balkans: Probably general.
This is one of the commonest plants in flower, in July and is abundant wherever there is enough shade and moisture. A white-flowered form was seen in an old orchard south of Snevce, 24-7-17.

Lapsana communis, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 74.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Xanthium spinosum, *L.*
Near Alexsia, in flower, 24-7-17, *Turrill*, 529.
Distr. Eur., Orient.
Balkans: Greece, Mtn., Serb., Bulg., Thrace.

Xanthium strumarium, *L.*
Near Alexsia, in flower, 24-7-17, *Turrill*, 527.
Distr. Eur., N. Afr., Orient, N. Asia.
Balkans: Greece, Mtn., Serb., Bulg., Thrace.

Campanulaceae.

Campanula lingulata, *W. K.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 65, 318; hills west by south of Kopriva, blue glomerate flowers, 15-5-17, *Turrill*, 219; foothills between Turica and Kopriva, 17-5-17, *Turrill*, 251.
Distr. S.-E. Eur.
Balkans: General north of Thessaly.

Campanula scutellata, *Griseb.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 243, 272, 280, 287, 399; foothills between Kopriva and Turica, in flower, 23-5-17, *Turrill*, 293; southern slopes of Krusa Balkan, near Karamudlı, in flower and fruit, 7-7-17, *Turrill*, 476.
Distr. Maced., Serb.

Campanula persicifolia, *L.*
Near Trinity Well, south-west of Turica, large, deep-blue flowers, 7-6-17, *Turrill*, 394; nullahs to south of Karamudli, in flower, 29-6 17, *Turrill*, 453.
Distr. N., Cent. and S. Eur., Asia Minor, N. Asia.
Balkans: General.
The two specimens recorded above have nearly sessile flowers. The species shows a considerable amount of variation in the shape, size and pubescence of the calyx-lobes and receptacle (ovary).

Campanula phrygia, *Jaub.*, var. **serbica,** *Adamov.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 41; Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 181, 314; Paprat District, Krusa Balkan, in flower, 5-18, *Russell*, 77; Struma Plain, about 3 km. south-east of Orljak, blue flowers, 20-4-17, *Turrill*, 75.
Distr. Maced., Serb.

Campanula Rapunculus, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 317; between Turica and Kopriva, in flower, 14-5-17, *Turrill*, 205; between Turica and Kopriva, in flower, 16-5-17, *Turrill*, 245.
Distr. Eur., N. Afr., Orient, N. Asia.
Balkans: General.

Campanula Spruneriana, *Hmpe.*
Southern slopes of Krusa Balkan, south-east of Karamudli, large blue flowers, 20-6-17, *Turrill*, 432.
Distr. Greece.
There is a considerable amount of variation in this species as regards the indumentum of the stems, the size of the corollas and the length of the calyx segments. These last are most often erect but in our specimens they are always spreading when the corollas have faded and sometimes before.

Campanula Spruneriana, *Hmpe.*, var. **lepidota,** *Turrill*, var. nov. A planta typica receptaculo (ovario) lepidoto differt.
Krusa Balkan, in flower, 6-18, *Harris*, 358; southern slopes of Krusa Balkan, south-east of Karamudli, large blue flowers, 20-6-17, *Turrill*, 432a.

Campanula athoa, *Boiss.*
Nullahs to south of Karamudli, amongst bushes, growing to 4 ft. in height, flowers, blue, 15-5-17, *Turrill*, 499.
Distr. Greece, Maced., Syria.

Specularia Speculum, *A. DC.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 15, 195; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 90; Struma Plain, about 3 km. south-east of Orljak, in flower, 20-4-17, *Turrill*, 81.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Specularia Speculum, *A. DC.*, var., **pubescens,** *A. DC.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris*, 242.
Distr. Occasionally with the type.

Jasione Heldreichii, *Boiss.*
Struma Plain and Krusa Balkan, in flower, 6 & 7-18, *Harris*, 329; near Trinity Well, south-west of Turica, in flower, 7-6-17, *Turrill* 395; southern slopes of Krusa Balkan, north of Karamudli, in flower, 29-6-17, *Turrill*, 447.
Distr. Balkans and northern part of Asia Minor.

OLEACEAE.

Jasminum fruticans, *L.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 221; about 3 km. south-east of Orljak, Struma Plain, yellow flowers, 20-4-17, *Turrill*, 91.

Distr. S. Eur., N. Afr., Orient.

Balkans: Greece, Maced., Alb., Bulg., Thrace.

Ligustrum vulgare, *L.*

About 2 km. east of Orljak, Struma Plain, 23-4-17, *Turrill*.

Distr. Eur., Orient.

Balkans: General.

Fraxinus Ornus, *L.*

Hills between Turica and Gumus Dere, 15-5-17, *Turrill*, 230.

Distr. Cent. and S. Eur., Orient.

Balkans: General.

APOCYNACEAE.

Vinca herbacea, *W. K.*

Krusa Balkan, in flower, 6-18, *Harris*, 396.

Distr. E. and S. E. Eur., Orient.

Balkans: Greece, Serb., Bulg., Thrace.

ASCLEPIADACEAE.

Periploca graeca, *L.*

Ravine between Turica and Kopriva, climbing over bushes, in flower, 29-5-17, *Turrill*, 347; Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 162.

Distr. S.-E. Eur., Orient.

Balkans: Greece, Maced., Alb., Mtn., Bulg., Thrace.

The corolla lobes are oblong to very slightly lanceolate-oblong with a rounded apex. Below they are pale yellow-green, above they are dark dull red-purple except for a pale yellow-green margin and apex and a grey blotch near the base. Short white hairs cover the basal part of the upper surface and gradually diminish in numbers towards the apex, becoming restricted at first to the sides, then to the margin, and finally disappearing altogether just below the apex. The hairs on each lobe are continued higher up towards the apex on the right side than on the left. The staminal corona consists of 5 long horns, alternating with the corolla lobes and each tapering to a slightly bifid apex. At the base of each there are two lateral projections, one on the left and one on the right, arising respectively from the right and left halves of the neighbouring corolla-lobes. On the inner face of each lateral projection a ridge runs longitudinally and directs itself to the left or right edge of the filament as the case may be. The whole corona is dark dull red-purple. The left and right projections of two contiguous corolla-lobes with their ridges and the left and right filaments surround the hole by which the pollinating insect can reach the pollinia. The filaments are broad and the connectives are covered with a dense tuft of white hairs, otherwise the whole stamen is of a pale yellow colour.

This plant has been suspected of poisoning Army horses.

Vincetoxicum speciosum, *Boiss. et Sprun.*
Hills between Turica and Gumus Dere, dull purple-black flowers, 5-6-17, *Turrill*, 375.
Distr. Greece, Mt. Athos, Bithynia.

Marsdenia erecta, *R. Br.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris*, 336; hills west by south of Kopriva, in bud, 15-5-17, *Turrill*, 244; hills between Turica and Gumus Dere, in full flower, 25-5-17, *Turrill*, 322.
Distr. Balkans, Orient.
Balkans: Greece, Maced., Alb., Bulg., Thrace.
A low, much-branched shrub, with opposite leaves and dense masses of white flowers. It has a very fine effect when in full bloom and then emits a fairly strong smell not unlike that of elder.
A specimen named *Vincetoxicum cordatum*, Adamov., in Herb. Kew, is *Marsdenia erecta*, R. Br., as is also the plant recorded from Cyprus as *Vincetoxicum officinale* by Thompson.

GENTIANACEAE.

Erythraea Centaurium, *Pers.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 169, 209; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 78; hills between Turica and Gumus Dere, deep pink flowers, *Turrill*, 377; south of Karamudli, pink flowers, 15-7-17, *Turrill*, 494.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

CONVOLVULACEAE.

Calystegia Sepium, *R. Br.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 74.
Distr. Eur., Orient, Temp. Asia, N. Amer.
Balkans: General.

Convolvulus Cantabrica, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 28.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Convolvulus arvensis, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 152, 313.
Distr. Most temperate and warm countries.
Balkans: General.

Convolvulus arvensis, *L.* var. **linearifolius,** *Chois.* (*Convolvulus acetoselloides*, Adamov. in Herb. Kew).
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 58: near Snevce, pink-white flowers, 24-7-17, *Turrill*, 536.
Distr. Commonly found with the type.
Most often prostrate but sometimes climbing up the bracken, etc., to 3 ft. Very common.

Convolvulus tricolor, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 227; "Buc-hill," near Kilindir, in flower, 1-6-17, *Baker*, 11; 8 km. north of Salonika, in flower, 13-4-17, *Turrill*, 55.
Distr. S. Eur., from Portugal to Dalmatia, N. Afr.
Boissier records this species from Bithynia but thinks it was a garden escape, and Halácsy records it from Zacynthus, otherwise Dalmatia appears to be the most easterly locality from which it has hitherto been recorded.

Convolvulus tenuissimus, *S. et S.*
8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 35.
Distr. S.-E. Eur., Orient, N. Afr.
Balkans: Greece, Maced.

Cuscuta Epithymum, *L.*
Gumus Dere, white flowers, 7-6-17, *Turrill*, 386.
Distr. Eur., N. Afr., Orient, N. Asia.
Balkans: Greece, Serb., Bulg.
Parasite on *Thymus* sp.

BORAGINACEAE.

Heliotropium suaveolens, *M. B.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 189; foothills south of Turica, white flowers with a very sweet scent, 27-5-17, *Turrill*, 341.
Distr. S.-E. Eur., Orient.
Balkans: Maced., Bulg., Thrace.

Symphytum bulbosum, *Schimper.*
8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 43.
Distr. Cent. and S. Eur., Troas.
Balkans: Greece, Mtn., Bulg., Thrace.

Anchusa officinalis, *L.*
Struma Plain and Krusa Balkan,, in flower, 4 & 5-18, *Harris*, 84; Uladaja Ravine and Gugunci, found in shady places, in flower, 14-6-17, *Baker*, 3; 8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 53; foothills south of Turica, red-purple flowers, 27-5-17, *Turrill*, 345; hills between Gumus Dere and Turica, deep violet flowers, 15-5-17, *Turrill*, 221.
Distr. Eur., Orient.
Balkans: General.
Two very distinct colour forms were recognized near Turica, the one with red-purple corollas the other with deep violet corollas. Besides the colour difference, *Turrill*, 345, has less acute sepals and a shorter style than *Turrill*, 221, but these characters vary independently as an examination of numerous living examples in the field showed.

Anchusa italica, *Retz.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 26, 153; foothills between Turica and Kopriva, in flower, 30-4-17, *Turrill*, 124.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.
A very fine-looking plant with fimbriate scales in the throat of the blue corolla.

Nonnea ventricosa, *Griseb.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 76, 142; foothills near Turica, white flowers with large calyces, 4 & 5-17, *Turrill*, 145.
Distr. S. Eur., Orient. ,
Balkans: Greece, Maced., Bulg., Thrace.

Cerinthe major, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 5, 303; Struma Plain, about 2 km. south-east of Orljak, *Turrill*, 111.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece.

Echium italicum, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 291; foothills between Turica and Kopriva, pale blue or pink flowers, 29-5-17, *Turrill*, 350.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.
A fine, tall plant, to 5 ft. in height, much branched. The flowers have long filaments.

Echium vulgare, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 88.
Distr. Eur., Orient, Temp. Asia.
Balkans: General.

Echium plantagineum, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 143, 187; Uladaja and Kilindir, in shady places, 16-6-17, *Baker*, 16; foothills between Orljak and Turica, large blue flowers, 29-4-17, *Turrill*, 112.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Bulg., Thrace.

Onosma tauricum, *Pall.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 122, 194; Uladaja Ravine, hill-side, in flower, 14-6-17, *Baker*, 2.
Distr. Austr.-Hung., Greece, Maced., Serb., Bulg., Thrace, Taurus.

Lithospermum purpureo-coeruleum, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 22, 130; 6 km. north-east of Lahana, Seres Road, hill country, in flower, 19-4-17, *Turrill*, 67.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Mtn., Serb., Bulg.

Lithospermum arvense, *L.*
Struma Plain and Krusa Balkan, in fruit, 4 & 5-18, *Harris*, 137; seed collected near Turica, 22-5-17, flowered at Kew, 25-5-18, *Turrill* (seed-number), 8.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Lithospermum Sibthorpianum, *Griseb.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 301.
Distr. Greece, Orient.
The stems in this specimen are ascending, not prostrate.

Lithospermum apulum, *Vahl.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 18; 8-10 km. north of Salonika, yellow flowers, 13-4-17, *Turrill*, 27.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Bulg., Thrace.

Myosotis idaea, *Boiss.*
8-10 km. north of Salonika, growing on the hill-side mixed with *M. collina*, Hoffm., *Turrill*, 12a.
Distr. Greece, Maced., Mtn., Bulg., Thrace, Asia Minor.

Myosotis cadmea, *Boiss.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 29, 266.
Distr. Greece, Maced., Bulg., Orient.

Myosotis collina, *Hoffm.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 131; 8-10 km. north of Salonika, small blue flowers, 13-4-17, *Turrill*, 12.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Myosotis intermedia, *Link.*
Between Turica and Kopriva, in flower, 12-5-17, *Turrill*, 196.
Distr. Eur., Orient, N. Asia.
Balkans: Greece, Mtn., Serb., Bulg., Thrace.

Cynoglossum pictum, *Ait.*
Struma Plain and Krusa Balkan, in flower and fruit, 5 & 6-18, *Harris*, 296, 359; near Turica, blue-veined flowers, 11-5-17, *Turrill*, 192.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.
The plant grows to a height of 4 ft.

Asperugo procumbens, *L.*
Kopriva, in flower, 30-4-17, *Turrill*, 130.
Distr. Eur., N. Afr., Orient, N. Asia.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

SOLANACEAE.

Datura Stramonium, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 230.
Distr. Cent. and S. Eur., Afr., Orient, Asia, etc.
Balkans: General.

Hyoscyamus niger, *L.* var. **pallidus,** *W.K.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 230a.
Distr. Eur., N. Afr., Orient, Temp. Asia, India.
Balkans: Probably general.

Solanum Dulcamara, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 288.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

SCROPHULARIACEAE.

Verbascum thapsiforme, *Schrad.*
Southern slopes of the Krusa Balkan, north of Karamudli, in flower, 10-7-17, *Turrill*, 484; east of Karamudli, in flower, 20-7-17, a form with the leaves and stems more densely tomentose than in 484, growing on the side of a nullah above a small stream, *Turrill*, 520.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Serb., Bulg.
This is a very common summer-flowering species on the hillsides. The plants stand up at intervals like sentinels.

Verbascum bulgaricum, *Vel.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 271; southern slopes of Krusa Balkan, east of Karamudli, 20-7-17, *Turrill*, 521.
Distr. Serb., Bulg.

Verbascum Blattaria, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 60; south of Snevce, in flower and fruit, 24-7-17, *Turrill*, 530.
Distr. Eur., N. Afr., Orient, N. Asia.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Scrophularia Scopolii, *Hoppe.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris*, 285; nullahs to south of Karamudli, flowers and fruits, 29-6-17, *Turrill*, 454; south of Snevce, 24-7-17, *Turrill*, 531.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Digitalis lanata, *Ehrh.*
Struma Plain and Krusa Balkan, in flower, 6 & 7-18, *Harris*, 368; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 80; Kilindir, in flower, 18-6-17, *Baker*, 15; hills between Turica and Gumus Dere, flowers dull-white with basal purple part and veins orange-brown, 25-5-17, *Turrill*, 321; south-east of Karamudli, southern slopes of Krusa Balkan, in flower and fruit, 20-8-16, *Turrill*, 418.
Distr. S.-E. Eur., Asia Minor.
Balkans: General.

Digitalis ambigua, *Murr.*
Southern slopes of Krusa Balkan, south-east of Karamudli, in flower, 20-8-17, *Turrill*, 419.
Distr. Cent. and S. Eur., Orient, N. Asia.
Balkans: General.

Digitalis viridiflora, *Lindl.*
Krusa Balkan, in flower, 6-18, *Harris*, 413.
Distr. Thessaly, Maced., Bulg., Thrace.

Gratiola officinalis, *L.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 297, 345; between Kasimli and Snevce, near a pool, white flowers, 1-7-17, *Turrill*, 460.
Distr. Cent. and S. Eur., Orient, N. Asia.
Balkans: Greece, Maced., Alb., Serb., Bulg., Thrace.

Linaria Elatine, *Mill.*
Between Kasimli and Snevce, yellow-blue flowers and fruit, 1-7-17, *Turrill*, 466.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Linaria genistaefolia, *Mill.*
Struma Plain and Krusa Balkan, in flower and fruit, 5 & 6-18, *Harris*, 216, 273, 290, 328; in a field near Turica, often growing to 3 ft. in height and much branched, in flower and fruit, 27-5-17, *Turrill*, 337.
Distr. S.-E. Eur., Orient, N. Asia.
Balkans: Thessaly, Maced., Alb., Serb., Bulg., Thrace.

Linaria simplex, *DC.*
Struma Plain and Krusa Balkan, in fruit, 4 & 5-18, *Harris*, 23; 8-10 km. north of Salonika, very small yellow flowers, 13-4-17, *Turrill* 19; seed collected near Turica, 5-5-17, flowered at Kew, 5-6-18, young fruit, 15-6-18, *Turrill* (seed-number), 1.
Distr. Cent. and S. Eur.. Orient.
Balkans: Greece, Thrace.

Linaria Pelisseriana, *Mill.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris* 237, 306; Struma Plain about 3 km. south-east of Orljak, blue flowers, 27-4-17, *Turrill*. 107.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Maced., Bulg., Thrace.

Veronica Anagallis, *L.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-18, *Harris*, 184; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 93.
Distr. Throughout the Northern Hemisphere.
Balkans: General.

Veronica verna, *L.*
Struma Plain and Krusa Balkan, in fruit, 5-18, *Harris*, 173.
Distr. Eur., Orient, N. Asia.
Balkans: Greece, Serb., Bulg.

Bartsia latifolia, *S. et S.*
6 km. north-east of Lahana, pink flowers, 19-4-17, *Turrill*, 70; hill-slopes south-west of Turica, in fruit, 5-5-17, *Turrill*, 158.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Euphrasia salisburgensis, *Funck.*
Western end of Krusa Balkan, overlooking Lake Doiran, white-blue flowers, 1-7-17, *Turrill*, 472.
Distr. Eur.
Balkans: General.

Orobanchaceae.

Orobanche ramosa, *L.*
Foothills between Turica and Kopriva, in flower, 21-5-17, *Turrill*, 282.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Orobanche nana, *Noë.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 35.
Distr. S. Eur., Orient, Madeira.
Balkans: Greece, Mtn., Serb., Thrace.

Orobanche Esulae, *Pančič.*
Near Ormanli, Struma Plain, in flower, 20-5-17, *Turrill*, 275a.
Distr. Serbia (near Nish, etc.)
This plant has been named from the description given in Beck's "Monogr. Orobanche," p. 237. The only character in which our plant fails to agree with the description is in the glabrous or nearly glabrous corolla. According to Beck the corollas of *O. Esulae* are glandular-pilose, but the example he figures is glabrous! Our plant, which was collected under difficulties, was parasitic on a *Euphorbia*, very probably *E. Esula*. Unfortunately it was sent home in a consignment which was submerged *en route* and afterwards salvaged. The submersion evidently damaged the specimen considerably and possibly destroyed the indumentum on the corollas. A few glandular hairs remain at the base of some of the corollas. The size, shape and colour given to Beck's figure of the corolla of *O. Esulae* match our examples exactly.

Orobanche minor, *Sutton.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 48; nullahs south of Karamudli, in flower, 15-7-17, *Turrill*, 505a.
Distr. Eur., N. Afr., Asia Minor.
Balkans: General.

Orobanche Picridis, *Schultz.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 47, 145; between Turica and Kopriva, in flower, 5-5-17, *Turrill*, 151.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Mtn., Serb.
Parasitic on *Lactuca* sp.

VERBENACEAE.

Verbena officinalis, *L.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 190, 391; near Turica, pink flowers, 21-5-17, *Turrill*, 287.
Distr. Most temperate regions.
Balkans: General.

LABIATAE.

Teucrium Chamaedrys, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 193; foothills between Turica and Kopriva, red flowers, 17-5-17, *Turrill*, 253.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Herz., Bulg., Thrace.

Teucrium Polium, *L.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris*, 339; southern slopes of Krusa Balkan, north of Karamudli, in flower, 29-6-17, *Turrill*, 446.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Ajuga genevensis, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 36, 182, 188.
Distr. N. and Cent. Eur., Asia Minor, Caucasus.
Balkans: Maced., Serb., Bosnia, Bulg.

Ajuga Chamaepytis, *Schreb.*
Struma Plain and Krusa Balkan, yellow flowers, 4 & 5-18, *Harris*, 73; between Orljak and Turica, in flower, 29-4-17, *Turrill*, 115.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkan: Greece, Mtn., Serb., Bulg.

Salvia argentea, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 97.
Distr. S. Eur., N. Afr., Asia Minor.
Balkans: Greece, Maced., Serb., Bulg.

Salvia amplexicaulis, *Rohb.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 292, 316; Buc-hill and Gugunci, in flower, 14-6-17, *Baker*, 13; near Turica, coll. Staff-Serg. Firth, red flowers, 17-5-17, *Turrill*, 266.
Distr. S.-E. Eur.
Balkans: General.

Salvia Horminum, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 24, 117; foothills between Turica and Kopriva, in flower 30-4-17, *Turrill*, 125; seeds collected near Turica, 6-6-17, flowered at Kew, 18-6-18, *Turrill* (seed-number), 40.
Distr. S.-E. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg.

Salvia clandestina, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 260; 8-10 km. north of Salonika, blue and white flowers, 13-4-17, *Turrill*, 11.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.

Ziziphora capitata, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 1, 232; foothills between Kopriva and Turica, red flowers in terminal capitula-like inflorescences, 17-5-17, *Turrill*, 248.
Distr. S.-E. Eur., Orient.
Balkans: General.

Scutellaria Columnae, *All.*
Foothills to south of Turica, in flower, 27-5-17, *Turrill*, 353.
Distr. S.-E. Eur., N. Afr.
Balkans: General.

Scutellaria albida, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 111; foothills near Turica, corollas yellowish-white, the lateral segments tinged with purple, 24-5-17, *Turrill*, 294.
Distr. S.-E. Eur., Orient.
Balkans: Thessaly, Maced., Bulg., Thrace.
Scutellaria Pichleri, Vel. non Stapf, is this species.

Prunella vulgaris, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 213, 256; Paprat District, Krusa Balkan, in fruit, 6-18, *Russell*, 19.
Distr. Cosmopolitan.
Balkans: General.

Prunella alba, *Pall.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 175, 410; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 29; foothills between Turica and Kopriva, white flowers, 4-6-17, *Turrill*, 371.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg.

Melittis Melissophyllum, *L.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris*, 264, 333; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 87; Struma Plain between Kopriva and Lake Butkova, coll. Staff-Sergt. Firth, 1-5-17, *Turrill*, 136; hills west by south of Kopriva, white flowers, 15-5-17, *Turrill*, 228.
Distr. Cent. and S. Eur.
Balkans: General.
All the plants enumerated above are large flowered with white corollas. A noteworthy character which seems fairly constant in most Balkan specimens examined by the writer is the large size of the calyx lobes, especially the adaxial lobe, which is sometimes much longer than the calyx tube and may be entire or bifid.

Lamium amplexicaule, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 133.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Lamium maculatum, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 322.
Distr. Eur., Orient.
Balkans: General.

Betonica officinalis, *L.*
West end of Krusa Balkan, overlooking Lake Doiran, in flower, 1-7-17, *Turrill*, 469.
Distr. Eur., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Stachys germanica, *L.*
Southern slopes of Krusa Balkan, west of Karamudli, in flower, 16-7-17, *Turrill*, 514a.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Stachys italica, *Mill.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 283.
Distr. S. Eur., Orient.
Balkans: General.
The inflorescence is very young and more compact than usual.

Stachys angustifolia, *M.B.*
Krusa Balkan, in flower, 6-18, *Harris*, 351; 3 km. south of Kocan mah, Krusa Balkan, in flower, 12-6-17, *Turrill*, 410.
Distr. S.-E. Eur., Tauria.
Balkans: Greece, Maced., Bulg., Thrace.

Stachys annua, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 34.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Stachys plumosa, *Griseb.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 69, 234, 286; *Turrill*, 189, near Kopriva, in flower, 9-5-17; near Trinity Well, south-west of Turica, in flower, 7-6-17, *Turrill*, 396.
Distr. Maced., Serb., Bulg.

Leonurus Cardiaca, *L.*
Jeni mah, pink hairy flowers, 14-7-17, *Turrill*, 491.
Distr. Eur., Orient, N. Asia.
Balkans: Greece, Maced., Mtn., Bulg., Thrace.

Phlomis pungens, *Willd.*, var. **laxiflora,** *Vel.*
Between Kurkut and Alexsia, in flower, 15-6-17, *Turrill*, 413.
Distr. (of var.) Maced., Bulg.

Phlomis samia, *L.*
Hills to south-west of Turica, in flower, 8-6-17, *Turrill*, 403.
Distr. S.-E. Eur., Asia Minor.
Balkans: Greece, Maced.
A tall plant with dull mauve flowers.

Marrubium peregrinum, *L.*
Jeni mah, east of Karamudli, in flower, 14-7-17, *Turrill*, 492.
Distr. Cent. and S.-E. Eur., N. Afr., Orient.
Balkans: General.
A low, much branched, sub-shrubby plant.

Marrubium vulgare, *L.*
Nullah to south of Turica, small white flowers, 6-5-17, *Turrill*, 171.
Distr. Eur., N. Afr., Orient, N. Asia.
Balkans: General.

Sideritis montana, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 30; between Turica and Kopriva, white flowers whose upper lips go brown as the flowers open, 17-5-17, *Turrill*, 258.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Sideritis lanata *L.*
Struma Plain, about 3 km. east of Orljak, small yellow and black flowers, 20-4-17, *Turrill*, 74.
Distr. Greece, Asia Minor.

Nepeta nuda, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 37; near Baisili, top of Krusa Balkan, in flower, 24-6-17, *Turrill*, 440.
Distr. S. Eur., Orient.
Balkans: General.

Glechoma hirsuta, *W.K.*
6 km. north-east of Lahana, large blue flowers, 19-4-17, *Turrill*, 60.
Distr. S.-E. Eur.
Balkans: Mtn., Serb., Bulg., Thrace.

Melissa officinalis, *L.*
Karamudli, Southern slopes of Krusa Balkan, in flower, 12-7-17, *Turrill*, 488; nullahs to south of Karamudli, 15-7-17, *Turrill*, 505.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Clinopodium vulgare, *L.*
Struma Plain and Krusa Balkan, in flower, 4-18, *Harris*, 107; Paprat District, Krusa Balkan, in flower, 5-18, *Russell*, 84.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Calamintha alpina, *Lam.*, var. **marginata,** *Borb.*
Southern slopes of Krusa Balkan, east of Karamudli, blue flowers, 9-7-17, *Turrill*, 480.
Distr. (of var.). Serb., Bulg.

Calamintha suaveolens, *Boiss.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 68, 165; hills west by south of Kopriva, in flower, 15-5-17, *Turrill*, 225.
Distr. Greece, Maced., Bulg., Thrace.
The colour of the flowers varies from deep lilac to pure white. All parts of the plant emit a very strong peppermint smell when crushed.

Origanum vulgare, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 67; nullahs to the south of Karamudli, in flower, 15-7-17, *Turrill*, 496.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Maced., Serb., Bulg.

Thymus Marschallianus, *Willd.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 104; 8-10 km. north of Salonika, pink flowers, 13-4-17, *Turrill*, 13; seeds collected on southern slopes of Krusa Balkan north of Karamudli, 7-7-17, flowered at Kew, 15-7-18, *Turrill* (seed-number), 70.
Distr. S.-E. Eur., Orient.
Balkans: General.

Thymus macedonicus, *Adamov.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 115; 8-10 km. north of Salonika, white flowers, 13-4-17, *Turrill*, 34.
Distr. Maced.

Thymus Chaubardi, *Boiss. et Heldr.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 98, 255; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 62; found generally round Gugunci and Kilindir, in flower 20-6-17, *Baker*, 22; foothills between Turica and Kopriva, in flower, 18-5-17, *Turrill*, 264.
Distr. Greece, Maced., Bulg.
The whole plant has a strong lemon smell.

Mentha sylvestris, *D'Urv.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris*, 338: Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 75; south-east of Karamudli, southern slopes of Krusa Balkan, in flower, 20-7-17, *Turrill*, 422.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Mentha Pulegium, *L.*
Weed in cultivated fields between Kasimili and Snevce, in flower, 1-7-17, *Turrill*, 462.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Lycopus exaltatus, *L.f.*
Krusa Balkan, in flower, 6-18, *Harris*, 389.
Distr. Cent. and S.-E. Eur., Orient, Temp. Asia.
Balkans: Thessaly, Corfu, Serb., Bulg., Thrace, Temp. Asia.

Lycopus europaeus, *L.*
Side of R. Spanc, south of Snevce, in flower, 17-7-17, *Turrill*, 517.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg.

PRIMULACEAE.

Lysimachia atropurpurea, *L.*
6 km. north-east of Lahana, in flower, 19-4-17, *Turrill*, 72a.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Bulg., Thrace.

Lysimachia punctata, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 203; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 34; nullah in foothills to south of Turica, yellow flowers, 27-5-17, *Turrill*, 332.
Distr. Eur., Orient.
Balkans: Greece, Maced., Alb., Mtn., Herz., Serb., Bulg.

Lysimachia nummularia, *L.*
Krusa Balkan, in flower, 6-18, *Harris*, 355; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 16; south-east of Karamudli, nullah in southern slopes of Krusa Balkan, in flower, 20-8-16, *Turrill*, 426.
Distr. Eur., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Anagallis arvensis, *L.*
Paprat District, Krusa Balkan, in flower and fruit, 6-18, *Russell*, 83; foothills between Orljak and Turica, in flower, 29-4-17, *Turrill*, 117b; between Kopriva and Kopriva Bridge, Struma Plain, in flower and fruit, 26-5-17, *Turrill*, 331a.
Distr. Nearly cosmopolitan.
Balkans: General.

Anagallis arvensis, *L.*, var. **carnea,** *Schrank.* (*A. amoena,* Heldr.)

Foothills between Orljak and Turica, corollas white with a dark purple patch in the centre, 29-4-17, *Turrill,* 117d; between Turica and Kocan mah, pink corollas, 12-6-17, *Turrill,* 408a.

Distr. Occasionally found with the type.

Anagallis coerulea, *Schreb.*

Foothills between Orljak and Turica, blue flowers, 29-4-17, *Turrill,* 117c; between Kopriva and Kopriva Bridge, in flower and fruit, 26-5-17, *Turrill,* 331b.

Distr. Nearly cosmopolitan.

Balkans: General.

Anagallis platyphylla, *Baudo.*

On a bank just north of Turica, in flower, 29-4-17, *Turrill,* 117a.

Distr. Algeria, Morocco.

The status of the various forms of pimpernel is an interesting and debatable question. The writer examined hundreds of living specimens in Macedonia with the aid of a pocket lens, and his observations and conclusions favour the views expressed by Dr. Moss in the Journ. of Bot., 1911, p. 44. In Macedonia both the scarlet and blue pimpernels grow abundantly in arable fields, waste ground and on unbroken hill-sides. Quite often their stems are intermixed, but the colour differences always remain definite. The following characters vary independently in both plants: stems prostrate or ascending, acuteness of sepals, number of fringing and glandular hairs on the margins of the corolla lobes, the number of cells in the fringing hairs. *Anagallis coerulea* has usually more markedly crenate corolla lobes which are, relative to their breadth, narrower than those of *A. arvensis,* so that the flower has a looser appearance, the petals not overlapping when the corolla is open. White and pink-flowered forms are not uncommon. They are evidently derivatives of *A. arvensis,* for a complete series of shades, from bright scarlet through pink to white may be found, but all retain the central blotch of dark purple. The flowers of the white form, recorded above under the var. *carnea,* turned pink while being dried between newspapers. At Kocan mah specimens were found in which the tints of the corollas of pink-flowered forms varied even on the same plant. *Anagallis platyphylla* has apparently hitherto been recorded only from North Africa. It may have been introduced into Macedonia with fodder. It is a very remarkable plant with broad leaves, three or four at a node, long slender peduncles, and blue corollas 2 cm. in diameter.

Cyclamen neapolitanum, *Ten.*

Krusa Balkan, in flower, 6-7-18, *Harris,* 416; Gumus Dere, in flower, 10-17, *Russell.*

Distr. Cent. and S. Eur.

Balkans: Greece, Thrace (?).

Primula acaulis, *Jacq.*
Near Gumus Dere, south of Struma Plain, 5-18, *Russell*, 7.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Macedonia. Serb., Bulg., Thrace.

PLUMBAGINACAE.

Plumbago europaea, *L.*
Akbunar, 9 km. north of Salonika, in flower, 9-10-17, *Turrill*, 549.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Serb., Alb., Bulg., Thrace.

Statice collina, *Boiss.*
Krusa Balkan, in flower, 6-18, *Harris*, 372.
Distr. Maced., Serb., Bulg., Thrace, Asia Minor, Syria.

Armeria Adamovicii, *Hal.*
Identified from the description in Osterr. Bot. Zeitschr., 1906, 279.
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, leaves slightly ciliate to glabrous, *Harris*, 44; Krusa Balkan, 6-18, a fine robust plant with densely pubescent leaves and large heads of white flowers, *Harris*, 370; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 22; near Mirova, white flowers, 13-6-17, *Turrill*, 409.
Distr. Maced.

PLANTAGINACEAE.

Plantago Psyllium, *L.*
8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 31.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Thrace.

Plantago arenaria, *W. K.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 170; near Karamudli, in flower, 29-6-17, *Turrill*, 449.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

Plantago Bellardi, *All.*
Hill slopes south-west of Turica, in flower, 5-5-17, *Turrill*, 156.
Distr. S. Eur., Orient.
Balkans: Greece, Maced., Alb., Herz.

Plantago Lagopus, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 300.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.

Plantago lanceolata, *L.*
Paprat District, Krusa Balkan, in fruit, 6-18, *Russell*, 40.
Distr. Most temperate regions.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

AMARANTACEAE.

Amarantus deflexus, *L.*

Krusa Balkan, 6-18, *Harris*, 401; near Kopriva, in flower and fruit, 4-6-17, *Turrill*, 369; near Karamudli, in fruit, 16-7-17, *Turrill*, 506.

Distr. S. Eur., N. Afr.

Balkans: Greece, Maced.

CHENOPODIACEAE.

Chenopodium Botrys, *L.*

In dried up sandy stream bed, west of Karamudli, 16-7-17, *Turrill*, 513.

Distr. S. Eur., N. Afr., Orient, Temp. Asia, N. Amer.

Balkans: General.

Spinacia oleracea, *L.*

Kopriva, female flowers, 12-5-17, probably an escape from cultivation, *Turrill*, 195.

POLYGONACEAE.

Rumex pulcher, *L.*

Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 284; Paprat District, Krusa Balkan, in fruit, 6-18, *Russell*, 89; between Turica and Kopriva, in fruit, 2-6-17, *Turrill*, 362.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: General.

Rumex dentatus, *L.*

Hills between Turica and Gumus Dere, flowers and white fruits, 5-6-17, *Turrill*, 383.

Distr. Egypt, Orient.

Balkans: Greece (?).

Rumex multifidus, *L.* (*R. acetoselloides*, Bal.).

Krusa Balkan, in flower, 6-18, *Harris*, 367; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 35.

Distr. Italy, S.-E. Eur., Orient.

Balkans: General.

Polygonum Convolvulus, *L.*

Western end of Krusa Balkan, overlooking Lake Doiran, 1-7-17, *Turrill*, 471.

Distr. Eur., N. Afr., Orient, Temp. Asia, etc.

Balkans: General.

Polygonum pulchellum, *Lois.*

Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 72; southern slopes of Krusa Balkan, near Karamudli, in flower, 12-7-17, *Turrill*, 486.

Distr. France, Italy, Balkans, Armenia.

Balkans: Greece, Maced., Bulg.

ARISTOLOCHIACEAE.

Aristolochia Clematitis, *L.*
The banks of the Struma, near Kopriva Bridge, pure yellow flowers, 19-5-17, *Turrill*, 273.
Distr. Eur., Orient, Cent. Asia.
Balkans: General.

Aristolochia pallida, *Willd.*
Hortac Plateau, about 1,600 ft., 12-14 km. north-east of Salonika, May 2nd, 1917, *Capt. A. J Carid.*
Distr. Cent. and S.-E. Eur., Asia Minor.
Balkans: General, north of Greece.
"The plant grew freely among the scrubby holly oak which abounds there, and also on ground which had been turned (*e.g.*, in making ditches) during the winter."

Aristolochia rotunda, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 11; 6 km. north-east of Lahana, in flower, 19-4-17, *Turrill*, 62.
Distr. Cent. and S. Eur.
Balkans: Greece, Maced., Herz.

EUPHORBIACEAE.

Euphorbia thessala, *Form.*
Struma Plain and Krusa Balkan, in flower and fruit, 6-18, *Harris*, 335.
Distr. Thessaly, Maced., Thrace.

Euphorbia Cyparissias, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 169, 261.
Distr. Cent. and S. Eur.
Balkans: General, north of Greece.

Euphorbia Esula, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 79.
Distr. Eur., Orient, Temp. Asia.
Balkans: General.

Euphorbia amygdaloides, *L.*
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 30.
Distr. Cent. and S. Eur., Orient.
Balkans: Maced., Alb., Mtn., Serb., Corfu, Bulg.

PLATANACEAE.

Platanus orientalis, *L.*
Gumus Dere, 10-17, *Russell.*
Distr. S.-E. Eur., Orient.
Balkans: Greece, Maced., Bulg., Thrace.
The leaves have very cuneate bases.

URTICACEAE.

Urtica pilulifera, *L.*

Hills south-west of Turica, near a ruined village, in fruit, 8-6-17, *Turrill* (seed-number), 41.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: Greece, Maced., Mtn., Thrace.

ULMACEAE.

Ulmus campestris, *L.*

A common tree in the Struma Plain, 22-4-17, *Turrill.*

Distr. Eur., Orient, N. Afr., Temp. Asia.

Balkans: General.

JUGLANDACEAE.

Juglans regia, *L.*

East of Karamudli, in fruit, 9-7-17, *Turrill.*

Distr. S.-E. Eur., Orient, N. India.

Balkans: Greece, Serb., Bulg.

CUPULIFERAE.

Quercus coccifera, *L.*

Foothills to south Turica, in flower, 27-5-17, *Turrill,* 335.

Distr. S. Eur., N. Afr., Orient.

Balkans: Greece, Maced., Alb., Mtn., Thrace.

Ripe acorns were gathered near Akbunar, 8 km. north-west of Salonika, in Oct. 1917. The plant seldom becomes more than a low shrub, 1 to 5 ft. in height, but small trees, with the leaves tending to lose their spines, were observed in the village of Turica and at the "Red Farm" near Akbunar. It is the characteristic plant of the "Lembert Hills" north of Salonika.

Quercus conferta, *Kit.*

6 km. north-east of Lahana, 19-4-17, *Turrill,* 68; east of Karamudli, southern slopes of Krusa Balkan, 9-7-17, *Turrill,* 483.

Distr. Italy, S.-E. Eur.

Balkans: Greece, Mtn., Serb., Bulg.

This is the common oak tree of Greek Macedonia.

Carpinus duinensis, *Scop.*

Nullah south of Turica, in fruit, 6-5-17, *Turrill,* 170.

Distr. S.-E. Eur., Asia Minor.

Balkans: General.

SALICACEAE.

Populus alba, *L.*

Ravine between Turica and Kopriva, 29-5-17, *Turrill,* 349.

Distr. Cent. and S. Eur., N. Afr., Orient.

Balkans: General.

Salix alba, *L.*

Banks of R. Struma, near Kopriva Bridge, in fruit, 26-5-17, *Turrill,* 329.

Distr. Eur., Orient, N. Afr.

Balkans: General.

BUTOMACEAE.

Butomus umbellatus, *L.*
Near Ormanli, Struma Plain, in flower, 20-5-17, *Turrill*, 278.
Distr. Eur., Asia.
Balkans: General.

*ORCHIDACEAE.

Limodorum abortivum, *Sw.*
Struma Plain and Krusa Balkan, in flower and fruit, 5-6-18, *Harris*, 204, 378; hills between Gumus Dere and Kopriva, 15-5-17, *Turrill*, 215.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.
Dark purple-green inflorescence and stem with dirty white-purple flowers.

Cephalanthera ensifolia, *Rich.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 57.
Distr. Cent. and S. Eur., N. Afr., Tem. Asia.
Balkans: Greece, Maced., Serb., Bulg.

Cephalanthera pallens, *Rich.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 246.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Alb., Serb.

Orchis Morio, *L.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 244, 382; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 21.
Distr. Eur., Orient.
Balkans: Greece, Mtn., Bosnia, Serb., Bulg., Thrace.

Orchis Morio, *L.*, sub-sp. **Skorpili,** *Vel.*
Hills between Turica and Gumus Dere, red flowers, 15-5-17, *Turrill*, 217.
Distr. Bulg.

Orchis coriophora, *L.*
Foothills to south of Turica, in flower, 27-5-17, *Turrill*, 333.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Alb., Serb., Bulg.
Lobes of labellum green, upper lip purple.

Orchis tridentata, *Scop.*
Foothills near Turica, pink flowers, 30-4-17, *Turrill*, 132.
Distr. Cent. and S. Eur., Orient.
Balkans: Mtn., Serb., Bulg., Thrace.

Orchis militaris, *L.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 102, 380.
Distr. Cent. and S. Eur., Orient.
Balkans: General.

* Determined by R. A. Rolfe.

Orchis purpurea, *Huds.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 229.
Distr. Cent. Eur., Orient.
Balkans: Thrace.

Orchis palustris, *Jacq.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 42, 87; Struma Plain, near Kopriva Bridge, purple flowers, 19-5-17, *Turrill*, 275.
Distr. Eur., Orient, N. Afr.
Balkans: Greece.

Orchis laxiflora, *Lam.*
Krusa Balkan, in flower, 6-18, *Harris*, 381.
Distr. W. and S. Eur., Orient.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Orchis maculata, *L.*, var. **saccigera,** *Rchb. f.* (*O. saccigera*, Brong., *Q. macedonica*, Griseb.).
Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 42.
Distr. S. Eur., Orient.
Balkans: General.

Orchis provincialis, *Balb.*
Krusa Balkan, in flower, 6-18, *Harris*, 379.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Thrace.

Orchis papilionacea, *L.*
Krusa Balkan, in flower, 5 & 6-18; *Harris*, 58, 408; foothills between Turica and Kopriva, pink flowers, 14-5-17, *Turrill*, 206.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Mtn., Serb., Thrace.

Orchis pyramidalis, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 63; Paprat District, Krusa Balkan, in flower, 6-18, *Russell*, 73; foothills between Turica and Kopriva, flowers entirely pink, 14-5-17, *Turrill*, 203.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Serb., Bulg., Thrace.

Orchis hircina, *Crantz.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 56; hills west by south of Kopriva, in flower, 15-5-17, *Turrill*, 243.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Serb., Bulg., Thrace.

Ophrys apifera, *Huds.*
Foothills near Turica, 24-5-17, *Turrill*, 295.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Serb.

Ophrys atrata, *Lindl.*
Struma Plain and Krusa Balkan, in flower, 4 to 6-18, *Harris*, 19, 100, 228, 400; near Gumus Dere, in flower, 5-18, *Russell*, 5, 6.
Distr. S. Eur., Asia Minor.
Balkans: Greece, Maced., Bulg.

Ophrys cornuta, *Stev.*
Struma Plain and Krusa Balkan, in flower, 4 to 6-18, *Harris*, 40.
Distr. S.-E. Eur., Transcaucasus.
Balkans: Greece, Maced., Herz., Bulg., Thrace.

Spiranthes autumnalis, *Rich.*
Krusa Balkan, in flower, 6-18, *Harris*, 417.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.

IRIDACEAE.

Iris Pseudacorus, *L.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 25; banks of R. Struma, near Kopriva Bridge, in flower, 19-5-17, *Turrill*, 269.
Distr. Eur., N. Afr.
Balkans: Greece, Serb., Bulg., Thrace.

Iris Reichenbachii, *Heuffel.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris*, 154.
Distr. S. Hungary, Balkans, north of Greece.
This is the purple form which = *I. balkana*, Janka. See Dykes, "The Genus Iris," p. 152.

Romulea Bulbocodium, *S. et M.*
8-10 km. north of Salonika, in flower, 5-2-17, *Turrill*, 8.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.

Gladiolus illyricus, *Koch.*
Struma Plain and Krusa Balkan, in flower and fruit, 4 & 5-18, *Harris*, 40, 278.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Crocus Boryi, *Gay.*
Krusa Balkan, in flower, 6 & 7-18 (?), *Harris*, 418.
Distr. Greece.

Crocus pulchellus, *Herb.*
Near Gumus Dere, 10-17, *Russell.*
Distr. Thessaly, Maced., Thrace, Bithynia.

AMARYLLIDACEAE.

Leucojum aestivum, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 311.
Distr. Cent. and S. Eur., Orient.
Balkans: General north of Greece.

Asparagus acutifolius, *L.*
Common amongst bushes of *Quercus coccifera*, 8-10 km. north of Salonika, 3-17, *Turrill.*
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Thrace.

Polygonatum latifolium, *Desf.*
Krusa Balkan, in flower, 6-18, *Harris*, 354.
Distr. S.-E. Eur., Temp. Asia.
Balkans: Mtn., Bulg.

Anthericum Liliago, *L.*
Krusa Balkan, in flower, 6-18, *Harris*, 347.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Thessaly, Serb., Bulg.

Asphodelus albus, *Willd.*
Near Gumus Dere, in flower, 5-18, *Russell*, 3; 6 km. north-east of Lahana, in flower, 19-4-17, *Turrill*, 69.
Distr. S. Eur.
Balkans: Thessaly, Maced., Mtn., Herz., Bosnia, Serb., Bulg.
Grows to 5 or 6 ft. in height.

Asphodeline liburnica, *Reichb.*
Krusa Balkan, in flower, 6-18, *Harris*, 405.
Distr. Italy, S.-E. Eur., Orient.
Balkans: General.

Lilium candidum, *L.*
Struma Plain and Krusa Balkan, in flower, 6-18, *Harris*, 415.
Distr. S. Eur., Orient.
Balkans: Greece (native?), Thrace.
This is apparently the wild form of *L. candidum*. It is more slender in habit than any specimen in the Kew Herbarium. The lower leaves are linear to linear-lanceolate, up to 7·5 cm. long and 0·5 cm. broad. Cataphyllary leaves are present on the whole length of the stem. The inflorescence consists of 3 flowers. The perianth segments are 4·5-5 cm. long in the dried specimens. The stamens are 2·7 cm. long, including the anthers, which are 6-7 mm. in length.

Fritillaria pontica, *Wahlenb.*
Krusa Balkan, in flower, 6-18, *Harris*, 236.
Distr. Maced., Bulg., Thrace, Asia Minor.

Tulipa australis, *Link.*
Struma Plain and Krusa Balkan, yellow flowers, 5-18, *Harris*, 263.
Distr. Cent. and S. Eur.
Balkans: Greece.

Gagea stenopetala, *Reichb.*
8-10 km. north of Salonika, in flower, 5-2-17, *Turrill*, 9.
Distr. Cent. and S. Eur.
Balkans: General.

Ornithogalum narbonense, *L.*
Between Kurkut and Alexsia, in flower, 15-6-17, *Turrill*, 412.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Bulg., Serb., Thrace.

Ornithogalum nutans, *L.*
Struma Plain and Krusa Balkan, in flower, 5 & 6-18, *Harris*, 62.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece.

Ornithogalum tenuifolium, *Guss.*
Struma Plain, about 4 km. south-east of Orljak, in flower, 20-4-17, *Turrill*, 73.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Mtn., Serb.

Ornithogalum fimbriatum, *Willd.*
8-10 km. north of Salonika, in flower, 13-4-17, *Turrill*, 52.
Distr. S.-E. Eur., Orient.
Balkans: Greece, Thrace.
This plant has conspicuously hairy leaves and peduncles.

Scilla bifolia, *L.*
Near Gumus Dere, 4-18, *Russell*, 13.
Distr. Cent. and S. Eur., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Scilla autumnalis, *L.*
Akbunar, 9 km. north-west of Salonika, in flower, 10-17, *Turrill*, 548.
Distr. Eur., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Muscari comosum, *Mill.*
Struma Plain and Krusa Balkan, young fruit, 4 & 5-18, *Harris*. 49; Paprat District, Krusa Balkan, in fruit, 6-18, *Russell*, 36; Struma Plain, about 2 km. south-east of Orljak, in flower, 26-4-17, *Turrill*, 105.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Mtn., Serb., Bulg., Thrace.
This is one of the most conspicuous of the spring plants in the Struma Plain.

Muscari racemosum, *L.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris*, 125.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Muscari pyramidatum, *Vel.*
Near Gumus Dere, 4-18, *Russell*, 10.
Distr. Bulg.

Allium rotundum, *L.*
Uladaja Ravine, on hill-side, 20-6-17, *Baker*, 20; foothills between Turica and Kopriva, deep red flowers, 14-5-17, *Turrill*, 204.
Distr. Cent. and S. Eur., Orient.
Balkan: Greece, Serb., Bulg., Thrace.

Allium sphaerocephalum, *L.*
Uladaja Ravine, on hill-side, in flower, 20-6-17, *Baker*, 20; southern slopes of Krusa Balkan, north of Karamudli, deep red flowers, 8-7-17, *Turrill*, 478.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Allium pulchellum, *Don.*
Krusa Balkan, in flower, 6-18, *Harris*, 412; southern slopes of Krusa Balkan, north of Karamudli, pink flowers, 16-6-17, *Turrill*, 415.
Distr. S. Eur., N. Afr., Orient.
Balkans: Mtn., Bulg.

Allium nigrum, *L.*
Struma Plain and Krusa Balkan, in flower and young fruit, 4 & 5-18, *Harris*, 61.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Serb.

Allium margaritaceum, *S. et S.*
Southern slopes of Krusa Balkan, west of Karamudli, white flowers, 16-7-17, *Turrill*, 510.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

JUNCACEAE.

Juncus glaucus, *Ehrh.*
Near Snevce, 24-7-17, *Turrill*, 534.
Distr. Eur., Asia, Afr.
Balkans: General.

Juncus acutiflorus, *Ehrh.*
Near Trinity Well, south-west of Turica, 7-6-17, *Turrill*, 392; side of R. Spanc, near Snevce, 17-7-17, *Turrill*, 516.
Distr. W., Cent. and S. Eur.
Balkans: General.

Juncus bufonius, *L.*
Near Ormanli, Struma Plain, 20-5-17; *Turrill*, 286; Struma Plain between Kopriva and Kopriva Bridge, 26-5-17, a form with the florets approximated into heads (=*J. hybridus*, Brot., *J. insularis*, Viv.), *Turrill*, 331.
Distr. Nearly cosmopolitan.
Balkans: Probably general.

Luzula Forsteri, *DC.*
6 km. north-east of Lahana, amongst bushes in a nullah, 19-4-17, *Turrill,* 66.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Serb., Bulg., Thrace.

Luzula campestris, *DC.*
6 km. north-east of Lahana, 19-4-17, *Turrill,* 58.
Distr. Most temperate regions.
Balkans: General.

ARACEAE.

Dracunculus vulgaris, *Schott.*
Struma Plain and Krusa Balkan, in flower, 5-18, *Harris,* 257.
Distr. S. Eur., Asia Minor.
Balkans: Greece, Maced., Mtn., Thrace.

CYPERACEAE.

Carex divisa, *Huds.*
Nullahs south of Turica, in the hills, 6-5-17, *Turrill,* 172; Struma Plain, near Ormanli, 20-5-17, *Turrill,* 280.
Distr. Eur., N. and S. Afr., Orient.
Balkans: Greece, Mtn., Herz., Serb., Bulg., Thrace.

Carex muricata, *L.*
8-10 km. north of Salonika, 13-4-17, *Turrill,* 45.
Distr. Eur. and Orient.
Balkans: Greece, Mtn., Serb., Bulg.

Carex divulsa, *Good.*
Foothills near Turica, 8-5-17, *Turrill,* 188.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Mtn., Serb., Bulg., Thrace.

Carex praecox, *Jacq.*
6 km. north-east of Lahana, 19-4-17, *Turrill,* 71; foothills near Turica, 30-4-17, *Turrill,* 118.
Distr. Eur., Orient, Cent. and N. Asia, N. Amer.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Carex flacca, *Schreb.*
Struma Plain and Krusa Balkan, in flower, 4 & 5-18, *Harris,* 116.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Carex flacca, *Schreb.*, var. **cuspidata,** *Aschers. et Graebn.*
Foothills near Turica, 3-5-17, *Turrill,* 146.
Distr. (of var.) S. Eur., N. Afr., Orient.
Balkans: Greece, Maced.

Carex flacca, *Schreb.* var. **pubicarpa,** *Rohl.*
6 km. north-east of Lahana, 19-4-17, *Turrill,* 63; foothills near Turica, 30-4-17, *Turrill,* 119.
Distr. Apparently only recorded previously from Montenegro.

Carex extensa, *Good.*
Struma Plain near Ormanli, 20-5-17, *Turrill,* 281.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Alb.

Carex ventricosa, *Curt.*
Foothills near Turica, 3-5-17, *Turrill,* 143.
Distr. W. and S. Eur.
Balkans: Greece.

Scirpus maritimus, *L.*
Near the R. Struma, Kopriva Bridge, 19-5-17, *Turrill,* 271.
Distr. Cosmopolitan.
Balkans: General.

Scirpus Holoschoenus, *L.*
Near the R. Struma, Kopriva Bridge, 19-5-17, *Turrill,* 272.
Distr. Cent. and S. Eur., N. Afr., Orient, N. Asia.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Cyperus rotundus, *L.*
Near Ormanli, Struma Plain, 20-5-17, *Turrill,* 279.
Distr. Most warm countries, including those of the Mediterranean region.
Balkans: Greece, Bulg.

Cyperus longus, *L.*
Growing to 5 ft. in height, near the stream at Trinity Well, south-west of Turica, 7-6-17, *Turrill,* 391.
Distr. Most warm countries, including those of the Mediterranean region.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

GRAMINEAE.

Sorghum halepense, *Pers.*
Big clumps to 4 ft. in height, Kopriva, 4-6-17, *Turrill,* 368; south of Karamudli, 13-7-17, *Turrill,* 490.
Distr. Native or introduced in most warm countries.
Balkans: General.

Chrysopogon Gryllus, *Trin.*
Hills between Gumus Dere and Turica, to 4 ft. in height, 15-5-17, *Turrill,* 214.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Setaria viridis, *P. Beauv.*
Near Baisili, at top of Krusa Balkan, 24-6-17, *Turrill,* 439; nullahs to south of Karamudli, 29-6-17, *Turrill,* 456.
Distr. Cent. and S. Eur., Orient, N. Afr., and introduced in many warm parts of the world.
Balkans: General.

Echinochloa Crus-galli, *P. Beauv.*
Near Alexsia, 24-7-17, *Turrill*, 526.
Distr. Most warm parts of the world.
Balkans: General.

Tragus racemosus, *Hall.*
Southern slopes of Krusa Balkan, north of Karamudli, 10-7-17, *Turrill*, 485.
Distr. Cent. and S. Eur., Orient, India, Africa.
Balkans: Greece, Serb., Bulg.

Cynodon Dactylon, *Pers.*
Near Trinity Well, south-west of Turica, 7-6-17, *Turrill*, 389.
Distr. Cent. and S. Eur., and most warm countries.
Balkans: General.
This is one of the commonest plants on the slopes north of Salonika. It comes up in the hardest ground of the camps around and even in the tents. With its long and creeping rhizomes it seems indestructible.

Anthoxanthum odoratum, *L.*
Paprat District, Krusa Balkan, 6-18, *Russell*, 46.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Mibora minima, *Desf.*
Struma Plain, about 2 km. east of Orljak, 23-4-17, *Turrill*, 97.
Distr. W. and S. Eur., N. Afr., Orient.
Balkans: Greece.

Phalaris arundinacea, *L.*
Banks of R. Struma, near Kopriva Bridge, 19-5-17, *Turrill*, 268.
Distr. Eur., Orient, Temp. Asia, N. Amer.
Balkans: General.

Alopecurus agrestis, *L.*
Struma Plain, about 2 km. east of Orljak, 26-4-17, *Turrill*, 99.
Distr. Cent. and S. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Alopecurus utriculatus, *Pers.*
8-10 km. north of Salonika, 13-4-17, *Turrill*, 20; Struma Plain, about 3 km. east of Orljak, 20-4-17, *Turrill*, 77.
Distr. S. and W. Eur., N. Afr., Asia Minor.
Balkans: General.

Echinaria capitata, *Desf.*
8-10 km. north of Salonika, 13-4-17, *Turrill*, 18.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Cynosurus echinatus, *L.*
Foothills between Turica and Kopriva, 23-5-17, *Turrill*, 290; seeds collected north of Karamudli, 29-6-17, flowered at Kew, 5-7-18, *Turrill* (seed-number), 60.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Agrostis verticillata, *Vill.*
Side of stream, near Trinity Well, south-west of Turica, 7-6-17, *Turrill*, 390; nullahs to south of Karamudli, 15-7-17, *Turrill*, 500.
Distr. S. Eur., N. Afr., Orient, Amer.
Balkans: General.

Agrostis vulgaris, *With.*
Paprat District, Krusa Balkan, 6-18, *Russell*, 33; southern slopes of Krusa Balkan, near Karamduli, 25-6-17, *Turrill*, 441; nullahs to south of Karamudli, 15-7-17, *Turrill*, 504.
Distr. Eur., Orient, N. Amer.
Balkans: General.

Apera Spica-venti, *P. Beauv.*
Southern slopes of Krusa Balkan, near Karamudli, 18-6-17, *Turrill*, 417.
Distr. Eur. (except parts of south), Temp. Asia.
Balkans: General, from Thessaly northwards.

Polypogon monspeliensis, *L.*
Struma Plain, between Kopriva and Kopriva Bridge, 26-5-17, *Turrill*, 330.
Distr. W. and S. Eur., N. and S. Afr., Orient, N. Amer., etc.
Balkans: General.

Gastridium lendigerum, *Gaud.*
Sarigol, near Kukus, 8-17, *Turrill*, 545.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn.

Milium vernale, *M. B.*
Struma Plain, about 3 km. north-east of Orljak, 20-4-17, *Turrill*, 80.
Distr. S.-E. Eur., Orient.
Balkans: General.

Aira capillaris, *Host.*
Struma Plain and Krusa Balkan, 5-18, *Harris*, 174; hill-slopes south-west of Turica, *Turrill*, 165.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

Holcus lanatus, *L.*
Near Karamudli, 21-6-17, *Turrill*.
Distr. Eur., N. Afr., Orient, Temp. Asia, N. Amer.
Balkans: General.

Avena barbata, *Brot.*
Foothills between Turica and Kopriva, 30-4-17, *Turrill,* 129.
Distr. W. and S. Eur., Orient.
Balkans: Greece, Maced.

Trisetum myrianthum, *Parl.*
Foothills between Turica and Kopriva, 24-5-17, *Turrill,* 302.
Distr. Italy, Greece, Alb., Mtn., Herz., Thrace.

Koeleria gracilis, *Pers.*
Foothills between Turica and Kopriva, 18-5-17, *Turrill,* 261.
Distr. Cent. and S. Eur., Orient, etc.
Balkans: General.

Koeleria phleoides, *Pers.*
Hill slopes south-west of Turica, 5-5-17, *Turrill,* 167.
Distr. W. and S. Eur., N. Afr., Orient, etc.
Balkans: Greece, Maced., Mtn., Herz., Bulg., Thrace.

Melica ciliata, *L.*
Between Turica and Kopriva, 12-5-17, *Turrill,* 197; between Turica and Kopriva, 2-6-17, *Turrill,* 365; seeds collected west of Karamudli, 9-7-17, *Turrill* (seed-number), 71.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Dactylis glomerata, *L.*, var. **hispanica,** *Roth.*
Paprat District, Krusa Balkan, 6-18, *Russell,* 38.
Distr. (of var.). S. Eur., Orient.
Balkans: Greece, Maced.

Vulpia Myurus, *L.*
Paprat District, Krusa Balkan, 6-18, *Russell,* 61; near Turica, 24-5-17, *Turrill,* 300.
Distr. Cent. and S. Eur., N. Afr., Orient, etc.
Balkans: General.

Bromus maximus, *Desf.*
Hill slopes south-west of Turica, 5-5-17, *Turrill,* 159.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Thrace.

Bromus sterilis, *L.*
Foothills near Turica, 4-5-17, *Turrill,* 152.
Distr. Eur., Orient, N. Afr., Temp. Asia.
Balkans: General.

Bromus tectorum, L.
Near Turica, 8-5-17, *Turrill,* 187.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Bromus scoparius, *L.*
Foothills between Orljak and Turica, 29-4-17, *Turrill,* 113.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Serb., Bulg., Thrace.

Bromus squarrosus, *L.*
Paprat District, Krusa Balkan, 6-18, *Russell*, 48; hills west by south of Kopriva, 15-5-17, *Turrill*, 220; near Trinity Well, south-west of Turica, 7-6-17, *Turrill*, 388.
Distr. S. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.
One of the panicles of *Turrill*, 220, is the variety **villosus,** *Gmel.*, the rest have glabrous spikelets. *Turrill*, 388, is a fine luxuriant form with large panicles and spikelets.

Bromus hordeaceus, *L.*
Between Turica and Kopriva, 21-5-17, *Turrill*, 283.
Distr. Eur., N. Afr., Orient.
Balkans: General.

Bromus commutatus, *Schrad.*
Foothills between Turica and Kopriva, 2-6-17, *Turrill*, 364.
Distr. Cent. and S. Eur., N. Afr., Orient.
Balkans: General.

Bromus arvensis, *L.*
Paprat District, Krusa Balkan, 6-18, *Russell*, 45; top of Krusa Balkan, near Baisili, 24-6-17, *Turrill*, 437.
Distr. Cent. and S. Eur., Orient, Temp. Asia.
Balkans: General.
One of the specimens of *Turrill*, 437, is the typical form of the species, the glumes being glabrous, or apparently so, when seen with a hand-lens. The second specimen has the glumes covered with dense white hairs, and is apparently the variety **seriostachys** *Hal.* (= var. *velutinus*, Duv.-Jouv. non *B. velutinus*, Schrad.), which is recorded from Thessaly.

Festuca ovina, *L.*, var. **valesiaca,** *Schleich.*
Foothills between Turica and Kopriva, 24-5-17, *Turrill*, 303.
Distr. (of var.). Cent. and S.-E. Eur., W. Asia, etc.
Balkans: Probably general.

Glyceria plicata, *Fries.*
Side of R. Spanc, south of Snevce, 17-7-17, *Turrill*, 515.
Distr. Cent. and S. Eur., N. Afr., Amer.
Balkans: General.

Scleropoa rigida, *Griseb.*
On dry banks near Turica, 24-5-17, *Turrill*, 308.
Distr. W. and S. Eur., Orient,
Balkans: Greece, Maced., Mtn., Thrace.

Briza maxima, *L.*
Hill slopes south-west of Turica, 5-5-17, *Turrill*, 163; fruits collected on southern slopes of Krusa Balkan, near Karamudli, 20-6-17, flowered at Kew, 5-7-18, *Turrill* (seed number), 52.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece, Maced., Mtn., Bosnia, Herz.

Poa trivialis, *L.*
Paprat District, Krusa Balkan, 6-18, *Russell*, 49.
Distr. Eur., Temp. Asia.
Balkans: Greece, Maced., Thrace.

Poa nemoralis, *L.*
Nullahs to south of Karamudli, 15-7-17, *Turrill*, 501.
Distr. Eur., Orient, Temp. Asia, N. Amer.
Balkans: General.

Poa bulbosa, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 75; 8-10 km. north of Salonika, 13-4-17, *Turrill*, 51.
Distr. Eur., N. Afr., Temp. Asia.
Balkans: General.

Poa concinna, *Gaud.*
8-10 km. north of Salonika, 13-4-17, *Turrill*, 36.
Distr. Cent. and S.-E. Eur.
Balkans: General.

Elymus crinitus, *Schreb.*
Between Turica and Kopriva, 17-5-17, *Turrill*, 256; near Trinity Well, south-west of Turica, 7-6-17, *Turrill*, 393.
Distr. S.-E. Eur., Taurus.
Balkans: General.

Hordeum leporinum, *Link.*
Between Turica and Kopriva, 12-5-17, *Turrill*, 198.
Distr. S. Eur.
Balkans: General.

Aegilops ovata, *L.*
Between Turica and Kopriva, 17-5-17, *Turrill*, 250.
Distr. S. Eur., Orient.
Balkans: General.

Aegilops triaristata, *Willd.*
Near Turica, 12-5-17, *Turrill*, 200; fruits collected on southern slopes of Krusa Balkan, north of Karamudli, 29-6-17, flowered at Kew, 15-6-18, *Turrill* (seed number), 59.
Distr. S. Eur., Orient.
Balkans: General.

Aegilops triuncialis, *L.*
Near Turica, 3-5-17, *Turrill*, 147; between Turica and Kopriva, 17-5-17, *Turrill*, 260.
Distr. S. Eur., Orient, N. Afr.
Balkans: General.

Brachypodium pinnatum, *P. Beauv.*
Nullahs to south of Karamudli, 29-6-17, *Turrill*, 455.
Distr. Eur., Orient, N. Afr., Temp. Asia.
Balkans: General.

Brachypodium sylvaticum, *R. et S.*
Paprat District, Krusa Balkan, 6-18, *Russell*, 47.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Brachypodium distachyum, *R. et S.*
Between Turica and Kopriva, 21-5-17, *Turrill*, 284.
Distr. Eur., N. Afr., Orient.
Balkans: Greece, Mtn., Thrace.

Lolium temulentum, *L.*
Hills between Turica and Gumus Dere, 25-5-17, *Turrill*, 315; southern slopes of Krusa Balkan, north of Karamudli, 16-6-17, *Turrill*, 416.
Distr. Eur., N. Afr., Orient, Temp. Asia.
Balkans: General.

Haynaldia villosa, *Schur.*
Between Turica and Kopriva, 12-5-17, *Turrill*, 199.
Distr. S. Eur., N. Afr., Orient.
Balkans: Greece.

Psilurus aristatus, *Duv.-Jouv.*
Foothills to south of Turica, 27-5-17, *Turrill*, 344.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

CONIFERAE.

Juniperus Oxycedrus, *L.*
Northern foothills of Krusa Balkan, to the south of Turica, in fruit, 27-5-17, *Turrill*, 336.
Distr. S. Eur., N. Afr., Orient.
Balkans: General.

FILICES.

Pteris aquilina,
Common round base and on top of Krusa Balkan, near Karamudli, 6-17, *Turrill.*
Distr. Cosmopolitan.

Asplenium Trichomanes, *L.*
Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 10; near Gumus Dere, 4-18, *Russell*, 14; nullah in hills to south of Turica, 6-5-17, *Turrill*, 176.
Distr. Temp. and sub-trop. regions.
Balkans: General.

Asplenium Adiantum-nigrum, *L.*, var. **acutum,** *Borg.*
Nullah in the hills to the south of Turica, 6-5-17, *Turrill*, 176a.
Distr. Eur.
Balkans: General.

Adlantum Capillus-Veneris, *L.*

Nullah in the hills to the south of Turica, 6-5-17, *Turrill*, 175; nullah west of Karamudli, 4-7-17, *Turrill*, 473.

Distr. Nearly cosmopolitan.

Balkans: Greece, Maced.

Ceterach officinarum, *Willd.*

Struma Plain and Krusa Balkan, 4 & 5-18, *Harris*, 9; 6 km. north-east of Lahana, 19-4-17, *Turrill*, 59.

Distr. Eur., N. Afr., Orient, Himalayas.

Balkans: Greece, Alb., Serb., Bulg.

Geographical Distribution.

Since the present paper only records 625 species and varieties of plants from Macedonia, probably about a quarter of the entire vascular vegetation, care is needed in drawing any general conclusions from it. Nevertheless, several interesting facts become clear when the distribution of the recorded plants is considered. Of the plants given in the list 228 are widely distributed in Europe and the Orient; 198 extend throughout the Mediterranean regions of South Europe, North Africa, and the Orient; 82 are limited to the Eastern Mediterranean, and may be termed the Oriental element in our flora, most often they occur only in the Balkans and Asia Minor, but sometimes reach Italy and have a wider distribution in Western Asia and Northern Africa; 21 occur in South-East Europe and often in Central Europe, but do not extend into Asia Minor; 36 are endemic in Macedonia and its immediate neighbours; 8 are endemic in the Balkans, but have a wider distribution than the last within the Peninsula. It is evident that the flora is predominantly Mediterranean and is most closely related to the Grecian Flora. Thus 105 species are common to Macedonia and Greece, but do not extend northwards into Bulgaria. Nevertheless, as one would expect from its geographical position, Macedonia links floristically Greece and Bulgaria, and the northern element is distinctly marked since 38 plants are recorded in our list which occur in Macedonia and Bulgaria, but not in Greece. An interesting feature about many of the endemics is that they are numerous in individuals and give a real facies to the vegetation.

The distribution of the following plants is peculiar or worthy of special mention:—

Nigella elata was previously known only from Asia Minor.

Dianthus leptopetalus is recorded from Macedonia, Thrace, S Russia and the Caucasus, but from neither Greece nor Bulgaria.

Orobus atropurpureus has a limited distribution in S. Italy, Sicily and N. Africa, but no record of its discovery in the Balkans has been found.

Rubus collinus has apparently not been previously recorded from the Balkans, although it is known from many Mediterranean countries.

Scabiosa sicula is known from Thrace, but not from Continental

Greece or Bulgaria, although it is widely spread both east and west of the Balkan Peninsula.

Carduus pycnocephalus var. *cinereus* was only known from the Caucasus and Transcaucasus.

Centaurea pullata was recorded only from Portugal, Spain, S. France and Egypt.

Convolvulus tricolor has not previously been recorded east of Dalmatia except for a doubtful record from Bithynia. It is common 8-10 km. north of Salonika.

Anagallis platyphylla is a native of Algeria and Morocco, and was possibly introduced with army fodder.

Orchis purpurea has only been recorded previously from Thrace in the Balkans.

Carex flacca var. *pubicarpa* was described from Montenegro, but has probably a wider distribution in South-East Europe.

XXXIII.—MISCELLANEOUS NOTES.

J. H. Lace, C.I.E., F.L.S.—A frequent visitor to the Kew Herbarium, and one held in very high regard by the members of the staff there, passed away in June last at his home at Exmouth, Devonshire. John Henry Lace was trained for the Indian Forest Department at the National Forest School at Nancy, France, and passed out in 1881. On arrival in India he was appointed to the Punjab, and soon made a name for himself as a keen forest officer and accurate botanist. During his service of over thirty years he served not only in the Punjab but in British Baluchistan, Bengal, and Burma. While in Baluchistan he made an extensive collection of plants which resulted in the publication of "A Sketch of the Vegetation of British Baluchistan" by himself and Mr. Hemsley in Journ. Linn. Soc. xxviii. (1891) p. 288. At one time he was Assistant Inspector-General of Forests, at another he was for a short while Principal of the Forest College at Dehra Dún, and again he once officiated as Inspector-General of Forests. His last appointment was that of Chief Conservator of Forests in Burma, which he held for about five years, doing excellent work not only in forest management but in the study of the flora of some of the less-known regions, such as the Shan States and the hills around Maymyo. His useful and accurate "List of the Trees, Shrubs, and Climbers of Burma" is the present standard work on the subject, and the beautifully prepared specimens collected by him are of the greatest value to Indian botanists. He presented a nearly complete set of his collections to the Kew Herbarium, and we are glad to hear that his own set has now become the property of the Herbarium of the Royal Botanic Garden at Edinburgh. Many new species found by him in the Burma forests have been described in the Kew "Decades" from time to time, chiefly by himself. His death at the age of over sixty years was rather sudden, and came as a shock to his many friends at home.

J. S. G.

E. J. Allard.—We record with regret the death of Mr. Edgar John Allard, Superintendent of the John Innes Horticultural Institution, Merton, which occurred on October 23rd from pneumonia following influenza.

Mr. Allard entered Kew as a young gardener in June, 1898, having received his earlier training in several nurseries and at the Cambridge Botanic Garden. He left Kew in August, 1899, to return to the Botanic Garden, Cambridge, on his selection to fill the post of foreman, and remained there until his appointment as the first Superintendent at Merton under Mr. W. Bateson.

In all the posts he filled Mr. Allard proved himself a man of conspicuous ability, and acquired that interest in and knowledge of the scientific side of horticulture which rendered all the work he did of so much value.

Added to his skill as a gardener he had a charming personality, and it was to this, as well as to his interest in his fellow-men, that his good influence with the young men and boys who came under him must be attributed.

Lady Barkly's Drawings of Orchids.—The Bentham Trustees have purchased from a London bookseller and presented to the Herbarium a collection of coloured drawings of plants comprising 51 drawings of orchids, native of British Guiana, 7 of orchids indigenous or cultivated in Jamaica, one of *Peristeria elata*, from Panama, and a drawing of *Psychotria corymbosa*, Swartz, marked "Highgate, June, 1854," and 66 of Cape plants belonging to numerous genera, including a few of Orchidaceae. The drawings of British Guiana orchids are mounted in a large folio volume, at the beginning of which is a printed inscription from which we learn that they were made from nature by Mrs. Barkly, and, from the dates written beneath the drawings, that they were made between 1850 and 1852. Many of these are localised and in many instances are named, some few, however, incorrectly, while several bear no inscription of any kind. Though unsigned, the drawings made in Jamaica are evidently by the same artist, Mrs. (afterwards Lady) Barkly, the first wife of Sir Henry Barkly, G.C.M.G., K.C.B., F.R.S., whose invaluable services to Kew and to botany are recorded in the prefaces to the "Flora Capensis," vol. iv. sect. 1, and vol. vi. The colouring of the flowers in these drawings is good, but the leaves are usually represented somewhat too yellow. As a whole they possess considerable merit and are a valuable addition to the Kew collection. Of especial interest are two which illustrate the female forms of *Cycnoches Loddigesii* and an undetermined species of *Catasetum*. Lady Barkly lived in British Guiana, where Sir Henry was Governor, from 1848 to 1853, and in Jamaica, whither her husband was transferred, from 1853 to 1856. She accompanied Sir Henry to Melbourne on his appointment to the Governorship of Victoria at the close of 1856, and died there on April 17th, 1857.

The drawings of Cape plants are, with very few exceptions, by Miss E. B. Barkly, daughter of Sir Henry by his first wife. Many of them, however, do not bear the artist's initials and are unnamed and unlocalised. S. A. S.

Botanical Magazine.—The following plants are figured in the number for July, August, and September:—*Sophora japonica*, Linn. (t. 8764), a native of China; *Ramondia serbica*, Pančic (t. 8765), from the Balkan Peninsula; *Gongora latisepala*, Rolfe (t. 8766), probably from Colombia; *Rhododendron argyrophyllum*, var. *leiandrum*, Hutchinson (t. 8767), from Western Szechuan; *Govenia tingens*, Poepp. & Endl. (t. 8768), a native of Peru; *Linum elegans*, Sprunner ex Boiss. (t. 8769), from Greece; *Alnus firma*, var. *Yasha*, Winkler (t. 8770), from Japan; *Stewartia serrata*, Maxim. (t. 8771), from Japan; *Polystachya Pobeguinii*, Rolfe (t. 8772), from Tropical Africa; *Hypericum laeve*, Boiss. & Hausskn. forma *rubra* (t. 8773), a native of Northern Syria and Kurdistan; and *Scabiosa Hookeri*, C. B. Clarke (t. 8774), from the Eastern Himalaya and Western China.

The number for October, November, and December contains figures of the following plants:—*Rhododendron orbiculare*, Decne (t. 8775), a native of Western Szechuan; *Mesembryanthemum fulviceps*, N. E. Br. (t. 8776A), and *M. Elishae*, N. E. Br. (t. 8776B), both from South Africa; *Primula sinopurpurea*, Balf. f. (t. 8777), from Yunnan; *Stewartia sinensis*, Rehd. & Wils. (t. 8778), from Western China; *Cereus Tunilla*, Weber (t. 8779), a native of Costa Rica; *Odontoglossum praevisum*, Rolfe (t. 8780), from Colombia; *Berberis Beaniana*, Schneider (t. 8781), from Western Szechuan; *Diascia Aliciae*, Hiern (t. 8782), from South Africa; *Mesembryanthemum edule*, Linn. (t. 8783), from South Africa; *Rhododendron oreotrephes*, W. W. Sm. (t. 8784), a native of Yunnan, and *Bulbophyllum Hamelinii*, Rolfe (t. 8785), from Madagascar.

Stevia Rebaudiana.—A reference to this plant as "the sweetest plant in the world" has recently appeared in the gardening press. It is a native of Paraguay, and was originally described as *Eupatorium Rebaudianum* by Dr. Bertoni. A considerable amount of information is given concerning it in the *Kew Bulletin*, 1901, p. 173, and it was figured in "Hooker's Icones Plantarum," t. 2816 (1906), where Dr. Hemsley transferred it to the genus *Stevia*.

A recent account of the plant together with details of analyses has been published by Dr. Bertoni in "Anales Cientificos Paraguayos," Jan., 1918. A summary of this paper is given in the West Indian "Agricultural News," xvii. No. 423, July 13th, 1918, p. 213, and from this and from Wehmer, "Pflanzenstoffe Phanerog.," p. 712, the following information has been extracted. The principal sweetening substances are a glucoside, eupatorin, or estevin, and its tripotassic and sodic salt, rebaudin. Both these substances are said to taste 150-180 times as sweet as sugar. The glucoside is obtained as a red crystalline substance with the probable formula $C_{42}H_{72}O_{21}$. The leaves also contain resins, tannic acid, wax, and a little oil.

The importance of the product of this plant is chiefly in its quality as a possible substitute for saccharine, over which it is claimed to have the folowing advantages:—

1. In not having any toxic effect, but being, on the contrary, wholesome.

2. In having greater sweetening powers.

3. In being capable of being employed just as it is found in its natural state, by using the leaves crushed to powder.

4. In the fact that it could be put on the market at a much lower price than saccharine.

The glucoside, which is the principal sweetening substance, should be known by the name of estevin, rather than by that of eupatorin, for the latter name has been applied to a bitter substance extracted from *Eupatorium perfoliatum*. The sweetening power of the dried leaf is said to be 40 to 45 times superior to that of any other known natural substance, and it contains no other active principle or harmful substance. The bitter aromatic resin has, on the contrary, a tonic effect on the digestive organs. As a nutrient, of course, the leaves could not replace sugar. Another advantage which the leaves possess is that they may be preserved dry without deterioration for an indefinite period. It is suggested that if cuttings or seeds could be obtained it would be interesting and perhaps profitable to make trial of the plant in the West Indies. Dr. Bertoni says that it could be easily cultivated, although the best means of multiplication would be by cuttings, suckers, and division of the stalk, especially the latter, since cultivated plants have not produced much fertile seed.

Several plants are known which have uncommon properties in relation to the sense of taste in human beings. *Sideroxylon dulcificum*, A.DC., an African plant, bears oblong or oval berries about two-thirds the size of an olive, at first dull green, but changing to a dusky red as they ripen. The seeds are clothed externally by a thin, softish pulp, only slightly saccharine, yet imparting to the palate an extraordinary impression by which the most sour and acidulous substances become intensely sweet, so that citric or tartaric acids, lime juice, vinegar, and all immature fruit of a sourish character lose their unpleasant qualities, and taste as if they had been solely composed of saccharine matter. To a certain extent the duration of these effects depends upon the amount of berries chewed and the degree of maturity they have attained. They tend to lose their peculiar principle if suffered to remain in a ripe condition for any considerable time. The natives of the Gold Coast use the berries to render their stale and acidulated kankies more palatable and in bestowing a sweetness on sour palm-wine. No records of chemical analyses of this plant have been traced, but a description of it and an account of its distribution will be found in the *Kew Bulletin*, 1906, p. 171. *Thaumatococcus Danielli*, Benth., is said to have somewhat similar properties to those described for *Sideroxylon dulcificum*.

A plant with opposite properties is the Indian *Gymnema silvestre*, R. Br., a member of the Asclepiadaceae. It has a greenish flower and thick, fleshy leaves, and, like most of the plants of this order, it produces a milky juice. When the leaves are chewed, sweet and acrid tastes cannot be perceived for some hours afterwards. An account of the chemical analysis of the leaves and fruits is given in the Pharm. Journ., 1904, 19, p. 234. It is there shown that gymnemic acid is the substance which

affects the sense of taste. This is not a glucoside, but has very weak acidic properties and acts upon the nerves or nerve-endings of the tongue. The plant has no toxic properties and no cyanogenetic compounds have been discovered in it. A resinous substance, also of an acidic nature, which has been obtained from it, was devoid of any anti-saccharine properties. From the leaves a crystalline substance (a laevo-rotatory modification of quercitol) and a sugar (inactive glucose) were also extracted, but the fruits contain no quercitol. W. B. T.

Life and Letters of Sir Joseph Dalton Hooker.* — It is appropriate that Sir Joseph Hooker's life should have been written by his godson—the son of his old friend, T. H. Huxley. The task must have been one of almost filial duty, and Mr. Leonard Huxley is to be congratulated on the manner in which he has performed it. It can have been no light matter to select and arrange the letters of a man whose span of life and width of activities were so abnormal. So full is this correspondence that to a great extent Sir Joseph tells his own story, especially as most of the letters are written in a free unrestrained vein, thus conveying a more faithful portrait of the man than if his more formal utterances only had been given us. In order that these two volumes should be fully appreciated, it is as well to have at hand Darwin's "Life and Letters," and "More Letters," as also Mr. Leonard Huxley's life of his father. The lives of the three men were inextricably interwoven, and flowed along the same channels; they aimed at the same ideals and were lifelong friends.

Like Darwin and Huxley, Hooker began life with a medical training. All three, too, undertook memorable voyages to the southern seas. Though the medical training was afterwards most useful to him, Hooker never took to the profession, but merely qualified in order to be taken by Sir James Ross on his famous Antarctic voyage in the *Erebus*.

This was his first opportunity, and well did he make use of it. He laid the foundation of the great botanical career which was to make him famous, and obtained materials for the first of his classic works, the Flora of the Antarctic, New Zealand, and Tasmania. A few years after his return from this voyage he went out to India and explored the Sikkim regions of the Himalayas with a success which Rhododendron lovers know so well, and which implanted in him a desire to systematize the Flora of India, a work upon which he was occupied on and off for half a century; for the Flora Indica met with many checks and was not completed till 1897.

On his return, that connection with Kew began which was destined to be the main scene of his life's labours. His father had been appointed Director in 1841, and between them for over forty years they controlled the destinies of that famous establishment. By the public generally, indeed, Sir Joseph Hooker will be best remembered for his work at Kew. It has often been said

* "Life and letters of Sir Joseph Dalton Hooker, O.M., G.C.S.I." Based on materials collected and arranged by Lady Hooker. By Leonard Huxley. 2 vols. John Murray. 1918.

that Kew, as we know it, is the creation of the Hookers. And this is true, for, from 1840 until 1885 (indeed, till 1905, for Sir Joseph was succeeded by his son-in-law, Dr. Dyer) that influence was dominant. Hooker would have been the first to acknowledge that the great transformations which took place at Kew during his directorate were largely owing to the assistance he received from Dr. (afterwards Sir William) Thiselton-Dyer. Indeed, it would have been impossible for Hooker to have performed as efficiently as he did the countless duties which fall to the lot of a director outside his actual sphere, without that aid. Dr. Dyer combined, in an uncommon degree, administrative ability and artistic instinct, which were invaluable to his senior.

It is not merely that visitors may wander about and enjoy the amenities of a luxurious garden, and in spite of the fumes and fogs of London and a not very congenial soil, a vast collection of plants, both in the open and under glass, but that its prestige and associations draw young gardeners and botanists to gain experience there and then to be dispersed all over the world, especially to British Dependencies, where the development of economic resources is of such paramount importance. One has only to glance at the lists of the staff in various botanic establishments to see how wide-felt is the influence of Kew. Much of this is due to the administration of Hooker. He knew how to choose and manage his subordinates. He was constantly in the gardens himself; he planned and designed, and in spite of Government parsimony managed to get such edifices as the fine Temperate House built. It was, we believe, Sir William Harcourt who once told the House of Commons when opposing a vote of money to add to this building, that "a nation who wants a Navy must do without a greenhouse." But in spite of this, it was eventually completed, thanks to the influence of Joseph Chamberlain. Then there is the unrivalled Library and Herbarium, the nucleus of which was got together by Sir William Hooker, and purchased by the Government at his death. Both have been enormously added to since his day, and no arrangement or classification of plants can be successfully accomplished without reference to Kew. Other collections may be richer in some particulars, but for working purposes Kew far surpasses any establishment of the kind.

Hooker fought valiantly for this, as he did for all that concerned the Gardens. Yet amidst his endless engagements and never-ceasing outflow of scientific work, he was always ready to take visitors round, from the Emperor of Brazil, who inconsiderately arrived one morning at 6 o'clock, to parties of young children. For many years, too, he and Lady Hooker had summer parties at their house, to which all that was eminent in science and society was drawn.

But Kew was far from absorbing all his energies; he was almost as great a traveller as botanist. His travels in the Himalayas, Syria, Morocco, and North America, were all productive of either books or papers of great value, and led to his becoming the highest authority on plant distribution of his time, and it is perhaps for his work in this direction that science owes him its greatest debt.

To quote the words of a high authority:—

"Hooker stands out as the greatest authority the world has yet produced on the subject of the distribution of plants; although he did much other work, this alone confers on him immortality."

The subject, which Darwin once described as "almost the keystone of the laws of Creation," was one upon which Hooker constantly wrote. The two essays which stand out pre-eminently are "On the Distribution of Arctic Plants" (1860) and "The Introductory Essay to the Flora of Tasmania" (1861). These have been described as "only less epoch-making than the Origin itself." His addresses to the British Association at Nottingham in 1866 and York in 1881 also dealt with this question, but he gave the world no comprehensive work embodying his matured views. At one time, he more or less advocated the 'extensionist' theory of Forbes that imaginary sunk continents explained many of the problems of distribution, but later he shared the 'migrationist' views of Darwin and Wallace, of the permanence of continents, and that the solution of the difficulties of plant distribution lies rather in the direction of processes going on around us now—a view further strengthened by the more recent researches of Dr. Guppy.

Hooker was President of the Royal Society from 1873 till 1878; he told Darwin he did not want to be "crowned head of Science" and looked on it as "an awful honour"; nevertheless, his presidency was very successful, and marked by several important changes, such as the reduction of fees, and a more systematic classification of scientific papers. The arrangements, too, for the expeditions to observe the transits of Venus in 1875 and 1878, as well as for the famous *Challenger* expedition, passed through his hands.

Perhaps more important than all was his lifelong friendship with Darwin. Darwin repeatedly acknowledged his indebtedness to Hooker. "You will never know how much I owe to you and your constant kindness and encouragement," are the words which Darwin's son quotes in dedicating the two volumes of "More Letters" to Hooker, and again "for years I have looked on you as a man whose opinion I valued on any scientific subject more than anyone else in the world."

He was present, along with Huxley, at the memorable meeting of the British Association at Oxford in 1860, when Bishop Wilberforce poured his unctuous scorn on Darwin. The story is too well known to need repetition. Huxley's reply to the Bishop has become historical, and Hooker, who had come against his will and quite unprepared, was goaded by the Bishop's bad taste and mis-statements into making a speech, and "hit him" (as he put it) "in the wind." "Sam was shut up—had not one word to say in reply—and the meeting was dissolved forthwith, leaving you" he wrote to Darwin, "master of the field after four hours' battle."

Oxford, it may be recalled, was also the scene, with the same Bishop in the chair, four years later, of Disraeli's famous "ape or angel" speech. To this day opinion is divided as to whether it was intended to be taken seriously or as a pompous joke. At

Oxford, once more, thirty-four years later, with Huxley again present but not Hooker, the late Lord Salisbury, then President of the British Association as well as Chancellor of the University, saw fit to make somewhat cynical references to Darwinism. Hooker thought them silly, and hardly had patience to read them. "I really thought he had more gumption," was his comment. Very different was his estimate of Mr. Arthur Balfour's address at the Darwin celebration at Cambridge in 1909: "he grasped every salient point in Darwin's character, works, and their results on the progress of science and civilisation in a truly magic manner."

Of Hooker's 'magna opera,' the Genera Plantarum, which he collaborated with Bentham, stands first. It marked, as Mr. Huxley justly observes, an epoch in botany. To complain that it does not produce a new system is to misconceive its object, which was, as Professor Bower explains, "to codify the diagnosis of all the genera of flowering plants." Its value lies in the accurate definition of genera, not in their classification. And it may be noted here that Hooker did not share Engler's views on classification, though phyletically it is undoubtedly an advance; he regarded it "in the abstract as neither better nor worse than De Candolle's, and far more troublesome to apply for practical purposes." This is comforting to the many who hold that until Science can supply something nearer finality, it is better to adhere to a widely accepted and established arrangement.

The work which has conferred the next greatest blessing on botanists is the 'Index Kewensis.' It object was, to use Professor Bower's words, "to provide an authoritative list of all the names that have been used, with references to the author of each, and to its place of publication." The idea was Darwin's, and he and his family bore the chief expense. It was carried out by Dr. Daydon Jackson, under the supervision of Hooker, who read the proofs—some 2,500 pages containing 375,000 names. This work, like the Genera Plantarum, has met with some criticism by those who expect to find in it a solution of vexed questions of nomenclature, but this is, of course, outside its scope. It does, however, form a guide of incalculable assistance to botanists, and it is satisfactory to record that four supplements have been issued since the work was first published, and that the work is being continued at Kew.

Of Hooker's powers as a descriptive writer we have ample evidence in his "Himalayan Journals," which has been justly described as one of the best books of travel ever written. One passage in a letter to his father, written from Tasmania, must be quoted; it makes us wish he had also embodied his Antarctic experiences in a book:—"At one time we thought we were really going on to the true South Pole, when we were brought up by the land turning from S. to E., where there was a fine volcano spouting fire and smoke in 79° S., covered all over with eternal snow, except just round the crater where the heat had melted it off. I can give you no idea of the glorious views we have here, they are stupendous and imposing, especially when there is any fine weather, with the sun never setting, among huge bergs, the water and sky both as blue, or rather more intensely blue than

I have ever seen it in the Tropics, and all the coast one mass of beautiful peaks of snow, and when the sun gets low they reflect the most brilliant tints of gold and yellow and scarlet, and then to see the dark cloud of smoke tinged with flame rising from the volcano in one column, one side jet black and the other reflecting the colours of the sun, turning off at a right angle by some current of wind and extending many miles to leeward; it is a sight far exceeding anything I could imagine and which is very much heightened by the idea that we have penetrated far farther than was once thought practicable, and there is a sort of awe that steals over us all in considering our own total insignificance and helplessness."

Fifty-six years later, when he witnessed the illuminated Fleet at Spithead, he declared he had seen but two sights to beat it, one was "the view of the glacier-clothed and berg-imprisoned mountain chain of South Victoria Land and Mount Erebus blazing in front. The other, the first view of the Himalayas, as seen from Darjeeling, covering perhaps 100° of one of the horizons with perpetual snow, with Kinchinjunga, 28,000 ft., towering over all."

Hooker was one of those men who had the gift of making great and lasting friendships; as a young man he quickly won the confidence of men like Sir James Ross and Lord Dalhousie, who encouraged his early efforts, and stimulated his zeal. To Henslow, his father-in-law, he was devoted, and it would be impossible to overestimate the value of his intimacy with Darwin and Huxley, already alluded to. "I have never known a man more genuinely beloved, and deservedly so," writes Mrs. Bewicke, "so child-like and ingenuous he was and so really modest, always putting others before himself, always unconscious of his own importance." He possessed pre-eminently the gift of making friends, and his correspondence shows how diligently he kept up with them, and how warmly they reciprocated his friendship. Alas! this tenderness of heart caused him many a bitter pang at parting as old age advanced. It is pathetic to read of the X Club, which kept together so long, at last dwindling away. One by one the old friends dropped off, the blanks were never filled, and the Club silently ceased to exist.

His love for his family was no less marked, he took the deepest interest in their welfare and upbringing, as the 'Lion letters' testify. These personal touches give an invaluable insight into Hooker's character.

Though in early life he did not enjoy particularly good health, his travels in the Antarctic, in the Himalayas, in Morocco, and in North America seem to have hardened him, and he became stronger as life advanced. "I am stoneware, you know," he wrote to Huxley, when nearing 80, "and shall have to be buried alive, if at all, I suppose." Except for occasional attacks of ailments, to which he was subject, he lived to enjoy a serene and robust old age, and retained his faculties in a wonderful degree to the last. Those who saw him at the Darwin celebrations at Cambridge in 1909 found it hard to realize that he was 92 years of age.

He was capable of enduring great physical fatigue. "I hope you will inherit my powers of walking," he once wrote to his son: "when I was a youth of 20 I thought nothing of 30 miles and have done 60 in the day." He was also endowed with indomitable industry and perseverance, and could work with but short intervals for sleep. He disliked public functions, and above all public speeches and lecturing, but when occasion demanded he showed that he was by no means deficient in these respects.

With Government officials his method was to persevere till he got his way. These pages disclose once more the details of his unfortunate quarrel with the redoubtable Mr. Ayrton, which disturbed many years of his life.

Mr. Ayrton, oddly enough, was born at Kew, and had had a long experience in India, but this did not prevent an acrid animosity towards Hooker. Mr. Ayrton was once described by Mr. Gladstone as the cleverest man in the House of Commons; he may have been, but he was certainly one of the most disagreeable. His dominating idea seems to have been to keep those under him in their places, especially "glorified gardeners." His conflict with Hooker eventually reached the House of Commons, but in spite of the intervention of Mr. Gladstone, and subsequent attempts of Sir Algernon West to pour oil on the troubled waters, no satisfactory conclusion was arrived at, and bad blood existed between the two men until, some years later, Ayrton was removed to another office. No wonder Hooker welcomed Mr. Mitford at the Office of Works; a man so much after his own heart was naturally drawn into a warm friendship, which was kept up with increasing intimacy long after both had retired from official life.

A word may here be said as to Hooker's political views. He never took any active part in politics, and allusions to current questions in his letters are not very numerous. His biographer tells us he was a "philosophical Conservative," whatever that may mean, "a strong Unionist, but not a Tory." "He disbelieved in the egalitarian tendencies of reforming Radicalism as emphatically as in the true Tory's impenetrability to ideas." He seems to have got on very well with Mr. Gladstone (with whom he shared a passion for Wedgwoods), in spite of the Ayrton trouble; and at the one recorded interview with Disraeli, he showed that he could be 'beautifully diplomatic,' and carried his point (a pension for Fitch), playing on the great man's imperialist feelings by showing him drawings of the Victoria Regia Lily!

His opinion of Government Departments was not more severe than one might expect from one who had endured Ayrton. "My experience of Public Departments is," he wrote to Darwin, "that they are riddled with small defects, and much idleness—and that in many respects they want overhauling—but not all," and "we are apt to forget that if red-tape has prejudice on its side, it also has experience."

As further evidence of the shrewd view he took of public affairs, it is impossible, at the present juncture, to refrain from quoting what he wrote to Mr. E. Darwin in 1893:—"I am

dreamer enough to look for a time when America will forbid a European war! What a splendid rôle this would be for a nation to undertake—to send us all to our tents and tell us that we may snarl at one another in the length and breadth of Europe as much as we please but nothing more, and that if we go further she will intervene." And in 1890 he wrote:—"Bismarck was not the only man of blood and iron in Germany; the whole of Prussia breathes arrogance, and this chirrupy young Emperor will soon be the tool of faction. He evidently has no conception of the difficulties and dangers of his position."

Such are some of the reflections which emerge from a perusal of the life and letters of this great man, for great he undoubtedly was, great in science, and great in character and achievement. It would have been a fitting culmination to an illustrious and honourable career if, as was proposed, he had been laid in Westminster Abbey beside Newton and Lyell and Darwin; but he wished for Kew, where his father was buried; and there, near the glades and dells he created, hard by the scene of his life's work, he was laid to rest, full of years, of honours, and of fame.

GERALD W. E. LODER.

Species Blancoanae.*—It is fortunate that the task of a critical review and interpretation of Blanco's *Flora de Filipinas* should have been undertaken by so competent an authority on the Philippine Flora as Prof. E. D. Merrill, whose knowledge of the vegetation of that archipelago, gained since the year 1902, is unrivalled. Just as Rumphius's *Herbarium Amboinense* (*see K.B.* 1918, p. 244) is of fundamental importance to students of Malayan botany and to a less extent of certain other parts of the world, so is Blanco's Flora in the case of the Philippine Islands. The first edition of Blanco was published in Manila in 1837, and contained descriptions, entirely in Spanish, of about 903 species of plants. A second edition containing 1,132 species under Latin binomials, and 27 under native names, appeared just after Blanco's death in April, 1845. Yet a third edition, greatly extended and illustrated, by Fathers Fernandez-Villar and Naves, appeared during the period 1877-1883, and it is this last edition which has given most trouble to Prof. Merrill, for reasons which are clearly stated.

Blanco's work is not merely a "botanical curiosity"† as it appeared to botanists of the middle of last century. It is the work of a man who had neither instructors nor herbaria, and whose literature at first was limited to the *Systema Vegetabilium* of Linnaeus! As Prof. Merrill says, "Few botanists in any country or in any time have laboured under greater disadvantages, and Blanco must be credited with initiative, industry and perseverance. Most of the facts recorded are the result of his own observation, and if he did make numerous grave errors in interpre-

* Species Blancoanae; a critical revision of the Philippine species of plants described by Blanco and Llanos, by E. D. Merrill; 423 pp. and a map; Manila Bureau of Printing, June 15, 1918.

† Hooker and Thomson, *Flora Indica, Introd. Essay*, 56 (1855).

tation of species, his descriptions, as such, on the whole compare favourably with those of his contemporaries. . . . Unfortunately Blanco preserved no herbarium material, and his species must be interpreted solely by the published data."

Prof. Merrill has found that Blanco frequently described the same species twice, or sometimes three or even four times, under different specific or generic names. In about 143 cases reductions have been made in this connection, so that the total number of different species actually described by Blanco amounted to about 993. Six hundred and ninety of these species were attributed to binomials of other authors on the assumption that they were the same. Prof. Merrill finds that about 60 per cent. of these determinations were incorrect. The vast amount of accumulated material of the Philippine flora and the author's own intensive knowledge have made it possible for him to determine the status of a very high percentage of Blanco's species. In this work Prof. Merrill seems to have derived more assistance from the vernacular names and uses of the plants than from the actual descriptions. For instance, no botanist, except perhaps by laborious exclusion, could ever have found out from the description of *Rhamnus lando*, Llanos, that a species of *Embelia* (*Myrsinaceae*) was intended. The native name *lando* was the key to it. Whenever possible he has interpreted a Blancoan species by specimens originating as near as possible from the exact quoted locality, that is by *topotypes*. An *exsiccata* of 16 sets of these has been prepared with a view to distribution to a selected list of botanical institutions in various countries. For this *exsiccata* the title *Species Blancoanae* has been selected. Reference to one of these sets will be incumbent on all students of Philippine and Malayan botany, and its arrival in Europe, postponed until more propitious times, will be awaited with considerable interest. By its means, monographers will no doubt now be able to account for many of Blanco's species, which in its absence would have been relegated to that most unsatisfactory group at the end—the "imperfectly known."

Prof. Merrill is to be warmly congratulated for a work which will be invaluable to all students of taxonomic and geographical botany of the Malay Archipelago. J. H.

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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

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XXXIV.—CHARLES OGILVIE FARQUHARSON AND HIS WORK IN WEST AFRICA.

It is with the deepest regret that his friends at Kew have learned that the name of Mr. C. O. Farquharson, Mycologist, Southern Nigeria, whose appointment was recorded in *Kew Bulletin*, 1911, p. 377, occurs in the list of passengers missing as the result of the loss at sea, through collision, of the homeward bound ss. "Burutu" on the night of 3rd October.

The keen enthusiasm brought to bear by Mr. Farquharson on his work, the sound judgment with which he confronted its problems, and the excellence of the results he had already achieved, afforded those interested in the future of West African Agriculture reason to expect for him a useful and distinguished career. We regret the tragic frustration of these hopes and lament the loss of a highly gifted and singularly attractive personality.

The following letter to the Assistant Director, dated 23rd September, and received at Kew on 15th October, was sent by the mail following the ill-fated vessel on which Mr. Farquharson sailed. The letter shows that he had a strong foreboding that his voyage home might end in disaster, and this is also indicated by its despatch by a later mail.

The letter is unlike any of the other letters sent by Mr. Farquharson from time to time to Kew, and is a remarkably graphic epitome of his life work in Nigeria. The nature of the work, the methods by which he sought to solve the many difficult problems, and the kind of education that his experience had led him to believe best for such work are all fully discussed. The views expressed apply to tropical plant pathology generally and are so worthy of consideration that the letter is published almost in its entirety. It is conceivable that but for his presentiment Mr. Farquharson would not in a single letter have embodied so fully his results and views.

(106.) Wt. 196—794. 1,125. 12/18. J. T. & S., Ltd. **G. 14. Sch. 12.**

Agricultural Department,
Ibadan, Nigeria.
23.8.18.

Dear Mr. Hill,

Kew hears so seldom from me that I suppose it has by this time " written me off " a bad example of ingratitude and possibly as a failure. I am writing now because I am ordered home by the next boat, which sails about the beginning of next month. This will be posted by the following boat and will tell you what I have been doing, in case the Boche prevents me telling you what news I have in person. I hope to get home all right and see Kew, but one never knows. At the end of this month I shall have completed 23 months' residence, and it will be bad luck to get done in on the way home. However, I want to get home for some things, and one must take the risk.

I may say that you haven't heard of me mycologically because, except for rare and brief intervals, I have not been mycologist this whole tour. I have been a Curator, the Curator in charge of the field labour here and at Agege. My scanty daylight leisure I have not devoted to mycology, because Ibadan, or our part of it, is mycologically arid. I do not suppose you wish to be deluged with fungi imperfecti, Phomas, Cladosporiums, and such like. There are no others. So effectively cleared is our place that I rarely see a Mycetozoon. I did them up before the clearance was complete. Under the inspiration of my former colleague, Dr. Lamborn, and encouraged by Professor Poulton, I have done little bits of entomology in my leisure, and perhaps know as much about the ways of getting at insect life histories and noting their relations to their environment as any other mycologist in the field and maybe a little more. With some knowledge of handling labour gained in 20 odd months gang driving of some two hundred men, my education, I think, I can consider fairly wide, and in West African conditions, fairly useful.

Forgive this preliminary blast on my own particular trumpet—it is not intended to be a world-resounding affair, but you may not be inclined to agree with some of my views later on, and I am merely putting in a varied experience to disarm criticism as far as possible. I ought to add that George Massee's economic-mycological outlook has influenced most things I have done, perhaps not as published, but in the intimate expression of his views that he used to give at Kew. Again and again I have wished he were alive. Kew wasn't the same place to me last time I was home.

My experience here, especially being in a position in which I was more or less responsible for getting up crops or giving a plausible reason for failure, has convinced me that every mycologist ought to be deprived of his microscope (and perhaps even of his pocket lens) for at least the first tour of his service, and perhaps for two years, and compelled to raise *normal* crops with no artificial aids of any sort. If possible, also, he should be compelled to study a really representative half-dozen drainage problems and see them solved by experts. He would greatly benefit by having to dig a few drains himself. I do not pretend

to be an expert, but for the first two months of this tour I did dig drains, bits of them myself, and supervised the digging of an open system, three feet (and even over) deep. I had to do this because I diagnosed asphyxiation to account for defoliation and die-back on some of our cocoa here. Several nights I was so dead tired by 7.30 that I had to turn in without dinner. I had a very bad leave last time, and came back here feeling anything but well. But I saw the water pouring out of a clay subsoil, as each spadeful of soil came out, and in due course I saw the cocoa trees shoot out leaf buds everywhere, and that was something. When I read descriptions of "wither-tip" of some crop with elaborate cultural data of some obscure *Phomopsis* or other idiotic fungus, I blush for the quack who wrote it. I know there are other causes of die-back in cocoa and other trees than lack of drainage. I have had such problems, but I am convinced that all of them can and must be solved without the aid of 1-12th in. objectives and Bordeaux mixture.

While I am on the subject of mycological quacks, let me tell you that to my mind the most outrageous are the entomogenous fungus "boosters." Massee shattered my faith in them. I had the luck to be in the Jodrell Laboratory when such a fungus came from the States, called *Aegirita Webberi*, named, I think, by Fawcett (California). "Aegirita" Webberi was the haustoria (moniliform clusters of cells) of a Perisporiaceous fungus (a sooty mould) which had grown on the secretions of the coccid it was said to kill. I regard the E.F.B.'s aforesaid as quacks, because so far I have met with none who attempted to find out when a coccid or any other insect dies a natural death, or conversely, proves insects to be immortal, apart from those carnivorous fungi. Mycologists are not the only people led astray by insects. I know a medical officer out here whose bonnet harbours an insect, not a bee, but the species of *Chrysops* which is the intermediate host of a *Filaria* (loa, I think). It doesn't occur here, but does in Sapele in particular. The medical officer came here a year or two ago, early in the rains (the spring). Seeing our nice fields of young maize, he asked, almost with a shudder, whether we got much trouble from red fly (*Chrysops*). I said it didn't occur at all, and he refused to believe me. I asked him why it ought to be here, and he told me he was certain its prevalence had a connection with young maize! He was so convinced that it was no use arguing that when the maize is young the dry season is over, the yams are young, the groundnuts are young, and that, in fact, it was the spring. And the fact is, of course, there *are* no *Chrysops* here. Our mycological bug-slayers overlook the normal seasonal periodicity of insects, and it seems to me that not a few have sprayed their fungus-spores just when the insect was about to go anyhow. The seasonal periodicity of insects is extremely well marked here. One day, going from my office to my quarters, I probably see dozens of "Painted Ladies" (*Pyrameis cardui*). Next day and for a few months they are not. Early in the rains for two or three days thousands of migrating Libytheine butterflies pass here flying southwards. The negro peasant knows that after that he may safely sow his cereal crops—

maize, at any rate. Towards the end of the rains swarms of the same butterflies return northwards. One may conclude that the rains are over. Between the flights to and from the forest belt we never see them. Unquestionably some of our insect pests are only pests when the agriculturist has failed. The agriculturist may not like to be told that. He doesn't object to be told to spray. There is a fine "act of God" feeling about it, so fine indeed that he doesn't even spray, but is satisfied with the belief that it *might* be done with success. The notorious West African cocoa "bark-sapper" (*Salbergella* sp.) in my experience is a pest on the careless agriculturist, a deserved visitation. A leading native grower here sent to the Department by one of our native instructors a collection of insect pests that were vexing him. They were bark-sappers. In the absence of our entomologist these things come my way (though I get no official credit). I sent the instructor to the plantation with a list of questions to answer as to the contour of the farm, soil and subsoil, whether the pest was worst at the top of any slopes on the farm or at the bottom, and if at the bottom whether the land was swampy. He came back, bringing trees (with roots) that he'd dug up. Before he said a word I knew from the stunted, gnarled tap-roots that the trees had grown on the most refractory laterite pan. He told me there was but 4 in. of soil above the laterite, and that the trees were on the top of a slope. At the bottom, near water, on rich soil there wasn't a sapper to be seen. I sent word to the owner that if he really wanted to grow cocoa on such a place he'd have to dig big holes and deep, and fill them up with compost. He would know himself, from his normal profit margin whether the expense would justify that method or whether it would be better to recognise that laterite was no soil for cocoa. When next I heard of him he had read my report in a meeting of the Agricultural Society of Ibadan and denounced my remedy (and me) as impracticable.

I noticed some time ago that ——, after listing various non-cocoa host plants of the bark-sapper which ought not to be planted near cocoa plantations (including *Acalypha* hedges in his proscribed list), goes on to mention that though *Salbergella* is a parasite of *Acalypha*, which is a hedge at Aburi, yet the cocoa there appears never to suffer from the bug's attentions. I am strongly inclined to think the reason is that the Aburi cocoa is *cultivated* and is in a position to keep the sapper at a distance. Thrips of cocoa is unquestionably a sequela of misguided agriculture. I hope you will not think I am unduly critical when I say that the average ——'s mental outlook is seriously distorted by a smattering of things entomological and mycological. They appear to me to think that because they know a bark-sapper or a root fungus and put down their names correctly that nothing more is to be said than that the trouble has been overcome by Bordeaux mixture or will probably respond to its application.

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If I had to map a course for a plant pathologist, I'd make a year's residence on a farm compulsory and make physiology, systematic and applied (the latter being essentially intensive

agriculture and including soil physics and meteorology) the chief subject. I would bar microscopes till the last year of the training. Every spare hour should be in the field. Particularly futile I thought was a course of mycological lectures I once attended, futile because the average student there didn't know what it was to go into the field. Undoubtedly the Aberdeen student under Professor Trail stood a better chance of being able to interpret things as they appear in the field. Field physiology, as opposed to laboratory physiology studied by means of beakers, tubes, and all sorts of ingenious appliances, is a study that wants developing. Let me illustrate my meaning from my own experience. The optimum planting date for American cotton here is about the 17th of July. Every day planting is delayed after that, in a *normal* rainfall year, increases the risk of a short crop. The great limiting factor after that is the Harmattan which comes on about November or December after the rains have stopped but before any marked response to that—in the way of leaf fall has set in. Once the Harmattan sets in (it is more or less intense from the start) defoliation is rapid. That is followed by a meagre flush of new foliage, the leaves of which are greatly reduced in size. Flowers may still and do continue to appear, but the bolls are undersized, are often badly worm-infested, and when mature their cotton is rarely worth picking. Now you might think that it would pay to plant a week or two or even a month earlier. Well, I tested the point by serial plantings, and found that June plantings or even more abnormally early are hopeless; the plants become the prey of the anthracnose fungus, Fusariums, physiological "red rusts," and dear knows what else. By the end of July they are the most stunted, miserable, flowerless, boll-less things you could imagine, blighted beyond recovery. I do not believe that spraying would be of the least good for the fungi (it would never pay on the bread-and-cheese cut-priced cottons we have to grow here), and even if the fungi were elminated there would still be the other physiological troubles. The groundnut here is another good instance. Groundnuts may be planted here up to the end of April (the rains begin with the tornadoes about the end of March or even earlier), or if the rains are late, into May. They will grow magnificent plants of a diameter of six or eight feet if not crowded, and will mature about mid-July or August. Let us say that up to the time when the vine has stopped growing and is on the turn it gets x in. of rain. We used to plant (up to 1914) about June and even later. Planting then, it is quite possible that the crop before the rains stop will get x in. of rain, at times more, at times less. But the bulk of the plants will be stunted, chlorotic, or mottled green and yellow, and instead of spreading normally (I am not referring to normal erect-growing types) grow *erect*, the leaves are very much reduced in size, and hardly any nuts are formed. When I came here in 1912 I never questioned the time of planting. I took it for granted as correct. I found myself up against this bunching and mottling, could find neither insects nor fungi, and the tubercles on the roots were apparently normal. The natives do not grow them much here, and, truth to tell, I didn't think of asking them about the crop. I couldn't get to Northern

Nigeria, where I knew the nuts *must* grow well, and had to make the best of it. I tried all sorts of ideas, but mainly kept my eyes open for a field clue. I got this indirectly when trying to solve a rather similar cotton (native type) problem. Up to 1914 our highest yield of groundnuts as harvested amounted to just over 500 lbs. per acre, which would probably have weighed about 300 to 400 lbs. when dry (unshelled nuts). We had many worse than that, that wouldn't bear recording, down to 11 lbs. per acre! Now normally we get from 1,000 to 1,300 lbs. of well dried nuts per acre (equivalent to about a ton as harvested). With the aid of lime I secured 1,700 lbs. once, but the liming had nothing to do with disease. In a ten-acre field one cannot see a "bunched" plant. The cotton disease that gave me the clue was solved in a different way. Up here "native" cottons are affected by a serious and incurable disease, of "physiological" origin. The plants get contorted. The leaves get covered with intumescences on the underside, and freak in the most extraordinary way. Flowering is greatly reduced, and, of course, bolling. The Upland Cottons (Americans of our introduction) were never affected. I found the solution of that from sheer field observation. Native plants near the coast, where the humidity average is much higher, grow normally. The key to the problem lay in the fact that the Americans were *upland* cottons. Their hirsuteness is an upland character. The natives (*G. vitifolium* and *peruvianum* strains) are glabrous. It took two whole tours before these obvious facts sank into my brain, but I doubt if anybody else would have done any better. The remedy for the disease was to grow the right cotton in the right place. Unfortunately for the cotton spinners, cocoa has long since ousted cotton from the high humidity belt. It was only from noticing a few stray survivors of bygone cultivation at Bonny that I tumbled to the cause of the trouble.

Before leaving the groundnut, I may say that my theory to account for the facts is that it is not the leguminous portion of the groundnut that suffers in the mid-rainy season planting, but the nodule organism that is "diseased" (perhaps from too low a soil temperature during the period immediately after it infects its host, or perhaps even before that it has become "involuted") or because the soil then being at its maximum wetness, the organism in the soil has become involuted. When it does infect the groundnut it either reverts to its ancestral parasitism, or, being itself at least below par, while not becoming a parasite, is yet unable to fulfil all the terms of the partnership. I may, as I have said, meet a Boche torpedo on the way home. If so, I hope you'll get someone to test my hypothesis. Further, I feel sure that something might emerge from a study of clover sickness along these lines at home. Could you induce someone to carry out serial plantings of clover varieties, both in England and Scotland? In the north of Scotland at least the disease doesn't occur. There may be some factor inhibiting out-of-season germination, either planting custom or meteorological.

Now you will see what I mean by field physiology. I doubt if any of the problems I have mentioned could have been solved in a laboratory, or at any rate only with the utmost difficulty

and good fortune. I do not suggest that the problems are solved in the ultimate sense, but at any rate I know the practical remedies, and that is a great deal.

As you know, I did find a real fungus disease last year, *Bagnisiopsis Dioscoreae* [see *K.B.* 1918, p. 199], not a very serious pest but quite noticeable and very striking indeed. And as you know, perhaps, we have been having a great time with coconut bud-rot. In regard to that disease, it seems to me that too much has been made of *Bacillus coli*, and the elementary fact has been lost sight of that dicotyledenous plants die back following asphyxiation of their roots for want of drainiage or other adverse soil factors. The first symptom is the death of the growing point of the main axis, if there is one, or of that and the side branches. Now, a palm has only got *one* to go on with, outside its fronds, and when that goes there is no hope of recovery. That growing point can "go" exactly as one or many of the growing points of a dicotyledonous tree may, and for the same reasons. The essential remedy is proper cultivation, growing the palms in the proper place on a proper soil in the proper way, with plenty of light and air. People have been so obsessed with the maritime habitat legend that they fail to see that the palm does well there because there are few competitors and it can get abundance of light to seaward and plenty of breeze.

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I hold strong views on cocoa disease out here, and to my thinking the key to the whole problem was indicated in that book by the late Secretary for Native Affairs, when he reminded us that "the native has no State-consciousness." The pest of cocoa *is* the native. He doesn't "cultivate" cocoa. He exploits a "weed" that yields a product closely allied to cocoa. I pointed this out to Government here. The great blight of cocoa is the fact that the native can exploit it at 10s. and less per cwt. cost of production of dried cocoa, and for years has sold it for 40s. and 50s. and even more. The best thing that could happen to Gold Coast and Nigeria native planters would be for them to be brought to the verge of ruin so that they might have to eat bread by the sweat of their brows and not ride in flash motor-cars by the exploitation of a product of the intelligent and painstaking selection of other races which happen to grow well, up to a point, in their country. I told the Government here that cocoa grew like a weed, that in fact it *had* to grow like a weed in order to survive. I illustrated this by reminding them how difficult it is to keep a prize vegetable (raised by long and intelligent selection) up to the prize standard. If it is put on poor land, is untended and generally neglected, it will have to revert to "weed-dom" if it is to survive at all, and if it does it will be no sweet and tender vegetable, but a hard-bitten, fibrous, just edible weed. The only remedy for West African cocoa is to let in European enterprise to "freeze out" the native if he fail to mend his ways. Cameroons cocoa is the same variety (largely) as Gold Coast and Nigerian. The soils are about the same. The difference in price of their product arises from this fact solely that Cameroons cocoa was prepared by natives as *servants* under the supervision of white

men who *had* a State-consciousness and valued their reputations. No amount of preaching will make the native improve. Adversity may force his hand, but he may simply revert to yams and cassava and trading wild stuff. I think he will, in fact, People talk at length about the phenomenal progress of cocoa on the Gold Coast. I took it on myself (when acting D. of A.) to tell the Government that it would have been better for the cocoa had the rate of increased production (which isn't progress if the product is the worst that comes into the world's market) been very much slower. I personally believe that the Western Ethiopian is as likely to change his skin as mend his ways. The facts of anthropology and ethnology are against him.

Last month a very interesting "disease" of Para rubber came my way, from a plantation at Sapele. They sent two large cases containing pieces of rubber tree stems and roots. No details were sent at all. They simply asked what was wrong with them. I could see nothing on the stems except *Diplodia cacaoicola*, which is no parasite of rubber, any more than of cocoa. However, I noticed two small rootlets with knobs on them about the size of a small hen's egg. I could see they weren't eelworm galls, but was inclined to think the roots were there by accident. One "gall" was not quite so decayed as the other, and in folds or depressions of it I noticed groups of hairs very similar to those of mite galls. Yet I couldn't believe that such things could be made by mites, and a section of the "gall" was not helpful. So I wired for more specimens of the galls, and got them—things like big lumpy potatoes, and some bigger, on *rubber roots* all right. This time came a letter, in which the manager said he also sent a small packet of a bush plant that seemed always to be growing near attacked trees, and wished to know if it had anything to do with the trouble. I opened up this package and was for the moment stumped. I thought they had nothing to do with the case. Kirby was looking at them, and probably thought the same. You will perhaps think I ought to have spotted them at once, but I am ashamed to confess that though I had often seen the bush plant I had never collected or studied it; but a dim recollection of Professor Trail's classroom came to me in a flash, and I *knew* it was one of the *Balanophoraceae*. I think it is *Thonningia sanguinea*. The Yorubas call it Ade-ile—the Crown of the Land, an unusually poetic and pretty fancy for these people. I remembered seeing it frequently in the bush at Agege, so, having to go down there to pay the labour, I looked them up and tried to follow out the roots of one to the bitter end. I take it that the tuberous parts are haustoria. The ordinary roots, which are densely clad with hairs (similar to those of the "galls"), are long things, extremely long for the size of the plants. Some I followed out for six feet or more and failed to find the ends of them. I had very little time, not enough in fact, to trace them to where they joined the host, and had to leave instructions for a native overseer to look for the "tubers." Some labourers apparently had seen the Ade-ile in our rubber plantation there, and so got on to them. Now, in connection with most fungus attacks I have personally seen hundreds of trees dug up from 1912 onwards and never yet met any "tubers" on the roots.

What was my surprise when the overseer sent me a perfectly astonishing tuberous mass on one of our rubber trees, quite twice the size of a big human head, and enfolding two quite large Para rubber roots. I am now not a little puzzled over this problem. Has Ade-ile always been there and been overlooked? (The tree on which it had fastened showed no ill effects, and it is not yet clear whether they do so at Sapele.) The plantation has a bad fungus history, and they also must have dug out lots of trees. I feel sure they would have made special records if they had found the *Balanophora*. Or has the parasite taken about ten years (from the time the plantation was laid out—ours dates from 1910) to overcome the resistance of the Para rubber tree?

With great regret I had to give a careful study of our stem (post tapping) disease of rubber at Agege the go-by. You may remember that I suggested that the longitudinal cracks on the tapped surfaces are external manifestations of internal "shakes" of the star variety. I saw enough last year, during brief visits to Agege to look after and pay labourers—not to mycologise, of course—to convince me that the trouble is physical and perhaps also physiological, and not the sequel to parasitism of any sort. However, I know that it is at its worst at the height of the rains. Four cuts (in the half herring-bone style) were made, and by the end of the season four tracts of outer cortex had been removed, each about 4 inches wide. It was evident at the end of the season that the location of the lesions had a definite periodicity which corresponded, as I have said, to the time when the rains were at their height. It seems to me that the longitudinal "fissures" in the unremoved layer of the cortex are the result of outward pressure of the growing central cylinder on the portion of the cortex weakened by excision of the outer layer in tapping. The weather conditions may either be such that callus-formation or bark-renewal is inhibited, or at any rate on the weakened place cannot keep pace with the excessive rate of growth that presumably occurs at the height of the rains. At any rate I think the phenomenon may be regarded as a "shake" of the cortex whatever the predisposing cause. Fungus attack may follow, but is by no means an invariable consequence, and there is frequently a normal renewal as the dry season ensues. The healed surface in such cases is irregular and "lumpy" and will be difficult ever to tap again, but the important point is that there may be no fungus-attack phase which appears to me strongly to support my hypothesis. If I get knocked out by the Boche you will at any rate be able to suggest to someone to attack the problem on these lines.

Now I must be closing. This letter will come by the mail following the one by which I sail. I hope to have the opportunity to tell you my theories in person and clear up what I have failed to express clearly. I am bringing some good *Balanophora* material, but apart from that I have nothing this leave. I must again thank Kew for all the help I've had and apologise for the meagre return.

Yours sincerely,

C. O. Farquharson.

XXXV.—CONTRIBUTIONS TO THE FLORA OF SIAM.

ADDITAMENTUM X.

W. G. CRAIB.

Evodia glomerata, *Craib* [Rutaceae-Zanthoxyleae]; species quoad inflorescentiam *E. simplicifoliam*, Ridley, simulans sed ex descriptione ab hac foliis fere semper trifoliolatis, foliolis oblongo-obovatis vel oblongo-oblanceolatis acuminatis acutis vix coriaceis differt.

Frutex circa 1·5-metralis (ex *Kerr*); ramuli juventute dense molliter albo-pubescentes, subflavidi, cortice mox rubescente, ad nodos parum compressi. *Folia* opposita, trifoliolata, rarissime unifoliolata, petiolo communi 2-5 cm. longo saepissime valido supra late sed haud alte canaliculato indumento ei ramulorum simili obtecto suffulta; foliola saepissime obovato-oblanceolata vel oblongo-oblanceolata, apice saepius breviter acuminata, costa excurrente apiculata, basi cuneata vel interdum acuminata, lateralia basi inaequilateralia, usque ad 14 cm. longa et 5 cm. lata, terminali lateralibus parum maiore, rigide chartacea, copiose pellucido-punctata, sicco supra fuscescentia, subtus pallida, pagina superiore ad costam nervosque laterales densius breviter pubescentia, indumento saltem costae persistente, inferiore molliter pubescentia et glandulosa, indumento mox plus minusve deciduo, nervis lateralibus utrinque circa 10-13 supra gracilibus palescentibus subtus validioribus prominentibus bene intra marginem anastomosantibus nervulis supra saepe conspicuis subtus prominulis, margine cartilaginea, densius breviter ciliata, sessilia vel petiolulo brevi suffulta. *Inflorescentia* axillaris, densa, petiolo dimidio brevior, vix 2 cm. diametro, pedunculo communi 1-2 cm. longo indumento eodem ac ramulis obtecto suffulta; flores breviter pedicellati; bracteae parvae. *Sepala* 4, subovata, acuminata, acuta vel obtusa, circa 1·75 mm. longa et 1·25 mm. lata, crassa, dorso glandulosa, puberula, intra glabra, ciliolata. *Petala* 4, conspicue glandulosa, oblongo-ovata, summo apice incrassata, cucullata, paulo ultra 3 mm. longa, 1·75 mm. lata, ciliolata. *Stamina* 4, glabra, filamentis 2 mm. longis, antheris oblongis 0·75 mm. longis. *Carpella* 4, rudimentaria.

Doi Sutep, 900 m., *Kerr* 3224.

Gynostemma siamica, *Craib* [Cucurbitaceae-Gynostemmeae]; ab affini *G. laxa*, Cogn., petalis saltem floris masculi haud subulato-acuminatis distinguenda.

Caules graciles, plurisulcati, nodos prope pubescentes, internodiis pilis perpaucis hic illic instructi. *Folia* trifoliolata, petiolo 3·5-6·5 cm. longo crispatim pubescente suffulta; foliola terminalia saepe parum inaequilateralia, plerumque subrhomboidea, apice breviter mucronata, 8-10 cm. longa, 4-4·7 cm. lata, petiolulo vix distincto vel ad 1 cm. longo suffulta, lateralia valde inaequilateralia, latere altero dimidiatim ovata, basi rotundata vel truncata, altero dimidiatim lanceolata vel oblanceolata, basi attenuata, apice mucronulata, 4·5-8 cm. longa, ad fere 4 cm. lata, breviter vel vix distincte petiolulata, omnia membranacea

vel tenuiter chartacea, pagina superiore pilis breviusculis rigidis hic illic instructa, inferiore pilis similibus sed plerumque costa nervisque tantum instructa, nervis lateralibus utrinque 5-8 pagina utraque conspicuis, nervulis supra obscuris subtus interdum paucis subconspicuis interdum obscuris, margine distanter haud alte serrulata, serrulis hydathodo apiculatis. *Flores* masculi in paniculas axillares folia subaequantes vel iis paulo longiores dispositi, ramulis ultimis densifloris, floribus parvis breviter pedicellatis. *Calycis* lobi oblongi, obtusi, 0·75 mm. longi, circa 0·3 mm. lati. *Corolla* expansa circa 3 mm. diametro, viridis (ex *Kerr*), petalis plus minusve ellipticis apice acutis breviterve acuminatis. *Androecium* circa 1 mm. altum, glabrum. *Fructus* globosus, viridis, circa 5 mm. diametro, seminibus subobovatis stramineis vel brunneo-stramineis corrugatis compressis 3-3·5 mm. longis lateribus sulcatis.

Doi Sutep, 690-900 m., evergreen jungle, *Kerr* 747, 1434, 2696.

Schefflera (Heptapleurum) siamensis, *W. W. Sm.* [Araliaceae-Panaceae]; species affinis *S. singalangensi*, Seem., *S. latifoliolatae*, King, et *S. venulosae*, Harms, ab omnibus quibus foliis subtus dense albo-tomentosis differt.

Arbor parva, circa 6 m. alta (ex *Kerr*); rami crassissimi, reliquis vaginarum valde corrugati, ad apicem latum fulvo-tomentosi. *Folia* petiolo ad 13 cm. longo albo-tomentoso tarde glabrescente praedita; vaginae latae, coriaceae, corrugatae; foliola 5-7, petiolulo circa 2·5 cm. longo subtus tomentoso suffulta, ad 20 cm. longa, ad 12 cm. lata, late elliptica, apice rotundata, nunc breviter et abrupte acuminata, nunc emarginata, basi rotundata, breviter cordatula, margine integra, sicco coriacea, supra pallide viridia, sublucida, glabra, infra dense albo- vel fulvido-tomentosa; costa media subtus prominens, albo-tomentosa; nervi 9-10-paria, utrinque manifesti; nervuli supra bene reticulati, infra tomento subcelati. *Paniculae* fructiferae tantum visae, laterales, pauciramosae, circa 7 cm. longae, ramulis primo albo-tomentellis tandem subglabris; pedicelli fructiferi inarticulati, circa 1 cm. longi. *Fructus* globosus, circa 8 mm. diametro, 10-12-locularis, rugis 10-12 alte notatus, stylis brevissimis haud connatis coronatus.

Doi Chieng Dao, 1650-1770 m., common on rocks, *Kerr* 2281.

Lysimachia lancifolia, *Craib* [Primulaceae-Lysimachieae]; a *L. ramosa*, Wall., cui affinis, caulibus vix glaberrimis haud alatis inter alia recedit.

Caules annui, erecti, circa 50 cm. alti, parce ramosi, sulcati, juventute glandulis parvis saepissime rubris breviter stipitatis densius tecti, glandulis mox plus minusve deciduis, superne virides, inferne pallidi brunnescentesve. *Folia* lanceolata, apice in apiculum gradatim angustata, basi attenuata vel subacuminato-attenuata, ad 6·5 cm. longa et 1·6 cm. lata, membranacea, supra viridia, pilis albis breviusculis subcrassis rubro-capitatis hic illic instructa praetereaque glandulis iis caulium similibus sparsissime ornata, subtus parum pallidiora, glandulis parvis iis caulium similibus sparse instructa, nervis lateralibus utrinque

4-5 obliquis supra saepe parum impressis subtus cum costa prominentibus, nervulis paucis subtus subprominulis, margine anguste revoluta, papillosa; petioli lamina decurrente superne alati, circa 1 cm. longi, supra canaliculati, cum caulibus glandulosi. *Flores* axillares, solitarii; pedicelli infructescentes saepissime 3-3·5 cm. longi, graciles, apicem versus incrassati, sparse glandulosi. *Calyx* in fructu persistens, 5-partitus, segmentis ovatis vel ovato-lanceolatis caudatis vix 3 mm. longis circa 1 mm. latis glanduloso-ciliatis dorso parce glandulosis. *Corolla* ignota. *Capsula* 5-valvis, calyce fere dimidio longior, glabra; semina fusca vel atro-rubra, angulata.

Doi Sutep, 1520 m., in evergreen jungle, *Kerr* 3132.

Damrongia, *Kerr*, gen nov. [Gesneraceae-Didymocarpeae]; a *Didymocarpo* calyce bilabiato recedit.

Calyx bilabiatus, labio postico trilobato antico bilobato, lobis posticis quam anticis paulo longioribus et conspicue latioribus mediano lateralibus maiore. *Corolla* exserta, tubo calyci subaequilongo superne inflato, limbo bilabiato, labio postico bipartito antico postico longiore paulo ultra medium in lobos tres inter se subaequales diviso. *Stamina* duo antica fertilia inclusa, filamentis paulo supra corollae tubi basem insertis rectis complanatis glabris, antheris cohaerentibus earum loculis divergentibus, rimis mox confluentibus; stamina lateralia ad staminodia redacta, postico [an semper?] omnino deficiente. *Discus* brevis, pistilli basem cingens. *Ovarium* superum, in calycis tubo inclusum, placentis intrusis bifidis facie exteriore multiovuliferis; stylus elongatus, stigmate obliquo apice emarginato. *Capsula* in calyce inclusa, valvis rectis demum ad summum apicem liberis.—*Herba* perennis, foliis omnibus basalibus membranaceis viridibus vix glabris penninerviis margine serratis saltem exterioribus longius petiolatis, pedunculis uni- vel pluri-floris, bracteis viridibus, floribus albis purpureo-lineatis mediocribus distincte pedicellatis.

Species unica siamensis.

Damrongia purpureo-lineata, *Kerr*.

Folia rosulata, quoad formam variabilia, plerumque obovata, elliptico-obovata, suboblonga vel rhomboideo-ovata, apice obtusa, rarius rotundata, basi cuneata, saepe inaequilateralia, usque ad 9 cm. longa et 5·8 cm. lata, membranacea, supra viridia, sparse albo-setulosa, subtus pallidiora, sparse sed ad costam nervosque densius adpresse brunneo-hirsutula, nervis lateralibus utrinque 4-5 supra subconspicuis parum elevatis subtus cum costa prominentibus paribus duobus infimis prope basem aggregatis obliquis primo rectis vel subrectis dein marginem versus prorsus curvatis, nervulis omnino obscuris, margine, parte basali excepta, subregulariter serrata; petioli usque ad 7 cm. longi, plurisulcati, supra canaliculati, pilis rigidis prorsus directis brunneis tecti. *Pedunculi* uni- vel pluri-flori, 3-5 cm. alti, indumento ei petiolorum simili tecti; bracteae lanceolatae, basi cuneatae, apice subacutae, 5 mm. longae, 2 mm. latae, virides, supra glabrae, subtus sparse brunneo- vel albo-setulosae; pedicelli 6-8 mm. longi, sparse

adpresse brunneo-setulosi. *Calyx* extra sparse adpresse brunneo-setulosus, 1 cm. longus, lobo postico lanceolato-deltoideo 4 mm. longo 2·5 mm. lato, lateralibus late lanceolatis vix 3·5 mm. longis 1·75 mm. latis, infimis angustius lanceolatis 2·75 mm. longis 0·8 mm. latis, lobis omnibus hydathodo subobtusis intra setulis perpaucis brevibus albis instructis margine pilis longiusculis transverse septatis distanter ciliatis, tubo postice 6 mm. antice 5 mm. longo. *Corollae* extra glabrae tubus elongatus, postice 1 cm. longus, pilis paucis crassus brevibus apice instructus; labium posticum e lobis duobus liberis apice rotundatis 4·5 mm. longis 3 mm. latis constitutum, anticum circa 7 mm. longum, 3-lobatum, lobis inter se subaequalibus oblongis apice rotundatis 4·5 mm. longis 3·5 mm. latis. *Stamina* duo antica fertilia filamentis 5·5 mm. supra corollae tubi basem insertis complanatis rectis 2·5 mm. longis glabris, antheris 1·5 mm. longis glabris cohaerentibus, loculis divergentibus rimis cito confluentibus; stamen posticum omnino deficiens, lateralibus ad staminodia circa 1·25 mm. longa glabra redactis. *Discus* vix 0·5 mm. altus. *Ovarium* in calycis tubo inclusum, 3 mm. altum, superne paucisetulosum, stylo stigmate incluso 9 mm. longo breviter subsparse setuloso, stigmate obliquo emarginato. *Capsula* 5-7 mm. longa, in calyce inclusa, valvis demum ad summum apicem liberis.

Gorge below Ban Kaw, c. 195 m. Flowers white with purple lines in throat; on damp rocks in jungle, *Kerr* 2196.

The plant here proposed as the type of a new genus, though undoubtedly closely allied to *Didymocarpus*, could not be satisfactorily placed in that genus or even in the genus formed by the union of *Didymocarpus* and *Chirita*, as proposed by some authorities. The habit, short fruit and calyx, separate it from any of the types at present represented in *Didymocarpus*. In degree—though not in kind—of divergence of habit and in its calyx *Damrongia* bears the same relationship to *Didymocarpus* as *Dichiloboea* to *Boea*.

The genus has been named in honour of H. H. Prince Damrong, who, himself interested in scientific pursuits, has done so much for the advancement of education in his country.

Petrocosmea Kerrii, *Craib* [Gesneraceae-Cyrtandreae]; a speciebus sinensibus foliis magnis facile distinguenda.

Herba acaulis; rhizoma satis crassum, breve, radicibus permultis rigide fibrosis. *Folia* rosulata, ovato-lanceolata, oblongo-elliptica vel rarius oblonga, interiora saepe suborbicularia, apice saepius obtusa, rarius acuta vel breviter subacuminata, basi cuneata vel cordata sed saepissime inaequialta, latere altero cuneata vel fere truncata, altero rotundata, semicordata, exteriora usque ad 10 cm. longa et 6 cm. lata, interiora multo minora, membranacea vel fere chartacea, pagina utraque pilis albis basi tumidis longiusculis dense ornata praetereaque subtus glandulis nitidis satis numerosis ornata, nervis lateralibus utrinque 4-6 pagina utraque subconspicuis vel inferiore conspicuis, nervulis paucis interdum subtus subconspicuis, margine irregulariter crassius denticulata vel serrato-denticulata; petioli foliorum exteriorum usque ad 9·5 cm. longi, satis validi, pilis

pallide brunneis longis transverse septatis divaricatis flaccidis tecti; petioli foliorum interiorum multo breviores, graciliores, indumento albo sparsius instructi. *Pedunculi* in plantis majoribus 3·5-4·5 cm. longi, cymam umbelliformam 3-florem gerens, pedicellis 1-1·3 cm. longis, in plantis minoribus saepissime uniflori, circa 3 cm. longi, pedunculis pedicellisque indumento ei petiolorum simili instructis. *Calyx* dorso pilis longis albis transverse septatis flaccidis pilosus, intra glaber; labium posticum fere ad medium 3-lobatum, vix 5 mm. longum, lobis oblongo-lanceolatis acutis 2 mm. longis 1·75 mm. latis margine paucidentatis pauperrime longe ciliatis, lobis duobus anticis in unum apice emarginatum connatis vel interdum fere ad basem liberis. *Corollae* tubus 3 mm. longus; labium posticum subquadratum, 6 mm. longum, 7·5 mm. latum, e lobis duobus connatis constitutum, lobis 2 mm. longis 3·5 mm. latis, anticum 7 mm. longum, 3-lobatum, lobis 4·75-5 mm. longis et 3·75-4 mm. latis, lobulis omnibus apice rotundatis margine pilis transverse septatis albis pauciciliatis extra breviter sparse albo-pilosis intra ad maculas glanduloso-furfuraceis. *Filamenta* prope corollae tubi basem inserta, 1·5 mm. longa, medio subitius expansa, inferne complanata, superne teretia, basi apiceque exceptis glanduloso-furfuracea; antherae apice conniventes, sagittatae, apice obtuse caudato-acuminatae, acumine incluso 3 mm. longae, loculis infra filamenti insertionem liberis; staminodia tria, parva, linearia. *Ovarium* 2 mm. altum, adpresse albo-pilosum, stylo terete 6·5 mm. longo apice glabro inferne glanduloso-furfuraceo et pilis paucis longis ornato, stigmate parvo capitato.

Doi Sutep, damp rocks in evergreen jungle, 1560 m., flowers white, two upper lobes with yellow patch at base, *Kerr* 3361.

Ruellia bella, *Craib* [Acanthaceae-Ruellieae]; a *R. suffruticosa*, Roxb., corolla longiore, a *R. macrosiphone*, Kurz, foliis latioribus recedit.

Fruticulus subacaulis. *Folia* approximata, oblonga, oblongo-elliptica vel oblongo-lanceolata, apice interdum subacuminata, obtusa, basi cuneata lateve cuneata, ad 7 cm. longa et 2·8 cm. lata, rigide chartacea, supra viridia, lineolata, pilis longiusculis pluriseptatis nitido-albis sparse instructa, subtus pallidiora, pilis iisdem ornata, nervis lateralibus utrinque 4-6 supra subconspicuis subtus cum costa prominulis, nervulis paucis subtus subprominulis, margine pilis albis septatis longe et dense ciliata. petiolo ad 1 cm. longo pilis iisdem subdense tecto suffulta. *Flores* axillares, solitarii vel bini, pedicellis brevibus vel sub anthesin ad 1 cm. longis indumento ei petiolorum simili tectis suffulti, pedicellis infructescentibus usque ad 2·5 cm. longis; bracteolae binae, foliaceae, oblongae vel oblongo-ovatae, ad 1·8 cm. longae et 1 cm. latae, sessiles, indumento ei foliorum simili tectae. *Calyx* viridis, persistens, circa 5 mm. longus, segmentis lanceolatis apicem versus gradatim attenuatis summo apice subacutis dorso medio inferne pilis paucis albis rigidis instructis intra pilis paucis brevibus tectis longius ciliatis rigidis. *Corolla* alba, nocte expansa (ex *Kerr*), extra basi excepta albo-pubescens, 5·2 cm. longa; tubi pars inferior cylindrica 2·3 cm. longa, circa

1·5 mm. diametro; lobi 5, inter se subaequales, plus minusve late elliptici vel late obovato-elliptici, apice rotundati, usque ad 1·1 cm. longi et 1·1 cm. lati, longius ciliati. *Stamina* fertilia 4, duobus longioribus tubi apicem vix attingentibus, filamentis glabris fere ad apicem tubi partis cylindricae affixis; antherae circa 2·25 mm. longae. *Ovarium* 3 mm. altum, nisi apice, ubi sparse pubescens, glabrum; stylus circa 4 cm. longus, setulosus.

Mê Măw, deciduous jungle, 300 m., *Kerr* 3605.

Asystasia salicifolia, *Craib* [Acanthaceae-Justicieae]; species floribus magnis, foliis saepissime elongatis cognoscenda.

Herba circiter 40 cm. alta, radice lignosa; caulis primo pilis albidis hic illic parcissime instructus, mox glaber, sicco pallide viridis, quadrisulcatus. *Folia* forma variabilia, plerumque late oblanceolata, oblanceolata vel linearia, apice acuminata, acuta vel acutiuscula, basi saepius cuneata, latiora circiter 10 cm. longa et 3·5 cm. lata, angustiora circiter 12 cm. longa et 1 cm. lata, chartacea vel membranaceo-chartacea, pagina utraque pilis longiusculis parce instructa, margine parum revoluta, pilis brevioribus rigidioribus scabridula, nervis lateralibus utrinque 7-10 pagina utraque conspicuis vel subprominulis; petioli breves vel usque ad 7 mm. longi. *Racemi* terminales, simplices, secundi, pedunculo incluso ad 5 cm. longi; pedicelli usque ad 3 mm. longi, pilis brevibus glanduloso-capitatis instructi; bracteae anguste deltoideae, acutae, circiter 2 mm. longae, rigidae, costatae; bracteolae binae, ad pedicelli basem positae, bracteis similes nisi minores. *Calycis* segmenta inter se subaequalia, linearia, acuminata, acuta, usque ad 8 mm. longa et 1·5 mm. lata, dorso pilis paucis saepissime glanduloso-capitatis instructa, apice breviter ciliolata. *Corolla* alba, purpureo-maculata (ex *Kerr*), vix 3·5 cm. longa, extra parce breviter pilosula, intus inferne ad nervos parce pubescens, lobis imbricatis apice rotundatis 7 mm. longis et 6-9 mm. latis. *Stamina* longiora corollae tubum paululo superantia, filamentis inferne parce pubescentibus; antherarum loculi circiter 2·5 mm. longi, basi distincte caudati. *Ovarium* dense pubescens et glandulosum, stylo inferne pilis divaricatis instructo.

Doi Sutep, open jungle, 1050 m., *Kerr* 1488.

Vitex Pierrei, *Craib* [Verbenaceae-Viticeae]; ab affini *V. canescente*, Kurz, pedicellis brevibus recedit.

Ramuli juventute densius molliter pubescentes, mox magis minusve glabrescentes, quadrangulares, demum glabri, teretes, cortice cinereo-brunneo obtecti, lenticellis numerosis haud valde conspicuis. *Folia* digitatim 5-foliolata, rarissime 3-foliolata, petiolo communi 3-7 cm. longo dense molliter pubescente suffulta; foliola ovata, oblonga, oblanceolato-obovata obovatave, apice acuminata vel caudato-acuminata, summo apice acuta, basi in petiolum attenuata, cuneata vel late cuneata, usque ad 7·5 cm. longa et 3·8 cm. lata, terminali aliis majore, duobus infimis interdum parvis saepe deciduis, chartaceis, pagina superiore pilis albis basi tuberculatis sparse nisi marginem versus ubi densius instructa, inferiore molliter pubescentia, praesertim ad

costam nervosque praetereaque aureo-glandulosa, nervis lateralibus utrinque 8-10 supra conspicuis subtus prominulis, margine irregulariter pauciserrata vel integra, petiolulis usque ad 2 cm. longis molliter pubescentibus suffulta. *Inflorescentia* ei *V. canescentis* persimilis nisi pedicellis minoribus, rhachi molliter pubescente et aureo-glandulosa; bracteae parvae, fugaces; pedicelli sub anthesin circa 1 mm. longi, ut calyx adpresse hirsutuli et aureo-glandulosi. *Calyx* 3·5 mm. longus, intra superne setulis paucis adpressis instructus, lobis inter se subaequalibus deltoideis acutis vel obtusis 0·75 mm. longis ciliatis. *Corolla* in alabastro extra breviter pubescens et densius aureo-glandulosa, sub anthesin 7 mm. longa; tubi pars basi cylindrica 2 mm. longa; labium supremum 2 mm. longum, ad medium bilobatum, lobulis apice rotundatis vix 1 mm. longis et 1·5 mm. latis; labium infimum 3-lobatum, lobo mediano lateralibus majore 2·75 mm. longo. *Stamina* exserta; filamenta basi papillosa. *Ovarium* apice dense glandulosum, 1 mm. altum, stylo filamentis longioribus subaequilongo apice bifido.

Srirăcha, 4·5 m., *Mrs. D. J. Collins* 72.

Distr. Cochinchina, *Pierre* 1839.

Elsholtzia Winitiana, *Craib* [Labiatae-Satureineae]; *E. blandae,* Benth. et *E. ochroleucae,* Dunn, valde affinis sed spicis densioribus inter alia distinguenda.

Plana perennis, ad 3 m. alta; rami (caulesve?) juventute pallidi, dense crispatim albo-pubescentes praetereaque rubro-glandulosi, mox brunnescentes, sparsius pubescentes, glandulis persistentibus. *Folia* lanceolata vel ovato-lanceolata, utrinque angustata vel interdum basi latius cuneata, summo apice mucronulata, ad 11·5 cm. longa et 3·8 cm. lata, chartacea vel membranaceo-chartacea, pagina superiore viridia, pilis brevibus albis sparse instructa, inferiore pallida, praesertim ad costam nervos nervulosque albo-pubescentia praetereaque glandulis rubris et aureis densius ornata, nervis lateralibus utrinque 6-9 adscendentibus intra marginem anastomasantibus supra conspicuis saepe parum impressis subtus prominentibus, nervulis subtus prominulis supra interdum parum impressis, margine parte basali excepta distantius crenato-serrata, parum revoluta, superiora subsessilia, inferiora petiolo ad 1·5 cm. longo supra late canaliculato densius crispatim albo-pubescente et glanduloso suffulta. *Spicae* in axillis foliorum superiorum solitariae, simplices, rarissime furcatae, cylindricae, 4-6 cm. longae, circa 5 mm. diametro, densiflorae, pedunculo communi 2-3 cm. longo indumento ei ramorum juvenilium tecto suffultae; bracteae oblongo-oblanceolatae, apice longe acute acuminatae, 3·25 mm. longae, 1 mm. latae, dorso pubescentes et glandulosae, intra glabrae, ciliatae, alabastra superantes; bracteolae bracteis similes nisi minores. *Calyx* vix 1·5 mm. longus, ore obliquo, inaequaliter lobatus, lobis plus minusve deltoideis acutis usque ad 0·5 mm. longis ciliatis, extra pubescens et glandulosus. *Corollae* tubus 1·5 mm. longus; labium anticum intra apice pilosum et glandulosum, posticum antico longius, circa 0·75 mm. longum, apice intra pilosum et glandulosum. *Stamina* bene

supra corollae tubi medium affixa, glabra. *Stylus* glabra, apice 2-fidus.

Doi Sutep, in mixed jungle, 660 m.; flowers greenish, aromatic, *Kerr* 1607B.

Croton siamensis, *Craib* [Euphorbiaceae-Crotoneae]; a *C. oblongifolio*, Roxb., inflorescentia dense argenteo-lepidota distinguendus.

Arbuscula (ex *Kerr*), ramulis primo densissime brunneo-lepidotis mox pallide brunneo- vel fere cinereo-corticatis. *Folia* saepissime oblonga vel oblongo-lanceolata, apice obtusa, breviter mucronata, basi rotundata vel cuneato-rotundata, ad 23 cm. longa et 7·5 cm. lata, chartacea vel saepius rigide chartacea, supra glabra, subtus pallidiora, distanter nisi ad costam densius lepidota, praetereaque facie utraque nigro- vel fusco-punctata, nervis lateralibus utrinque 10-15 rectis intra marginem anastomosantibus pagina superiore subconspicuis inferiore prominulis, nervulis subtus conspicuis vel subprominulis, margine distanter glanduloso-denticulata, petiolo ad 4·5 cm. longo densissime lepidoto supra canaliculato summo apice latere utroque glanduloso suffulta; stipulae subulatae, circa 3 mm. longae, deciduae. *Racemi* ad apices ramulorum aggregati, numerosi, circa 23 cm. longi, fere sessiles, densissime argento-lepidoti, mox brunneo-lepidoti, bracteis 1-2 mm. longis deciduis vel saepe flore delapso persistentibus, inferne flores ♀ superne flores ♂ gerentes, floribus subsessilibus vel breviter pedicellatis. *Fl.* ♂. *Calyx* intra superne parce albo-pubescens, vix 3 mm. longus, fere ad basem 5-partitus, segmentis deltoideis acutiusculis ciliatis. *Petala* 5, 2·75 mm. longa, 0·75 mm. lata, densius villoso-ciliata, dorso lepidibus stellatis paucis magnis ornata, supra parce pilosa. *Disci* glandulae calycis segmentis oppositae, 1 mm. latae, carnosae, glabrae, albidae. *Stamina* 10-12, 4 mm. longa, oppositipetala basi parcissime piloso-barbata vel interdum fere glabra, oppositisepala inferne gradatim densius villoso-barbata, connectivo lato. *Receptaculum* villosum. *Fl.* ♀. *Calyx* ei maris similis. *Disci* glandulae petaloideae, 1·75 mm. longae, vix 0·5 mm. latae, ciliatae. *Ovarium* dense stellato-lepidotum, stylis simpliciter divisis.

Srirăcha, Nawng Yai Bu, 15 m., common in evergreen and scrub jungles, *Kerr* 2146. Srirăcha, c. 6 m., very common, *Mrs. D. J. Collins* 239; ibid., c. 3 m., *Mrs. D. J. Collins*, 224.

Siamese name, Mai plau (ex *Kerr*).

Dalechampia elongata, *Craib* [Euphorbiaceae-Plukenetieae]; species nova foliis trifoliolatis, foliolis elongatis cognoscenda.

Caules volubiles, herbacei, fistulosi, virides, sulcati, juventute pilis brevibus albis crispis dense tecti praetereaque pilis paucioribus longioribus divergentibus instructi. *Folia* trifoliolata, petiolo communi ad 6 cm. longo sulcato indumento ei caulium simili tecto suffulta; stipulae diu persistentes, cito reflexae, lanceolatae, acutae, 4 mm. longae, dorso breviter crispatim pubescentes, margine longius ciliatae; foliola plus minusve lanceolata vel lateralia latere altero dimi io

anguste lanceolata, altero dimidio ovato-lanceolata, apice longe gradatim attenuata, summo apice costa excurrente breviter apiculata, basi acuminata, subacuminata vel lateralia latere exteriore rotundata, usque ad 15·5 cm. longa et 4·3 cm. lata, chartacea, supra pilis albis longiusculis basi tumidis mollibus vix dense instructa, subtus pallidiora, brevius molliter pubescentia, nervis lateralibus utrinque circa 15 supra cum costa pallescentibus subprominulis subtus prominulis intra marginem anastomosantibus, costa subtus prominente, fere integra nisi lateralia latere exteriore ubi latissima crasse pauci-dentata, margine anguste recurva, densius ciliolata, subsessilia vel petiolulo usque ad 6 mm. longo suffulta. *Inflorescentia* androgyna, ramulum axillarem unifoliatum ad 10 cm. longum terminans, pedunculo ad 7 cm. longo indumento ei caulium simili tecto suffulta, basi bracteis duabus foliis similibus nisi minoribus et paulo ultra medium lobatis vel fere ad basem partitis vix oppositis ornata, bractea quaque stipulis duabus iis foliorum similibus instructa, floribus ♀ ad bracteae inferioris basem, floribus ♂ ad bracteae superioris basem sitis. *Flores* ♂ basi bracteis duabus oblatis circa 5 mm. longis et 9 mm. latis pagina utraque puberulis pauperius ciliolatis cincti; alabastra depresso-globosa, puberrula; pedicelli circa 2 mm. longi, sub apice articulati. *Calyx* in segmenta 5 inter se vix aequalia ovato-elliptica apice incrassata subcucullata 4 mm. longa crassa intra basi pubescentia partitus. *Stamina* numerosa, filamentis circa 0·75 mm. longis parce pubescentibus, antheris vix 1·25 mm. longis, loculis parallelis. *Inflorescentia* ♀ triflora, floribus basi bracteis tribus membranaceis dorso puberulis et parce pubescentibus margine longe ciliatis una subquadrata apice cuspidato-acuminata 6·5 mm. longa et 7 mm. lata, aliis apice subtruncatis fere dimidio minoribus arcte cinctis pedicellis 1-1·75 mm. longis puberulis et parce pubescentibus suffultis. *Sepala* 5, inter se vix aequalia, tentactuligero-fimbriata, ad 2·5 mm. longa et 2 mm. lata, dorso puberula, ciliata, crassa. *Ovarium* 3-lobatum, circa 1 mm. altum, longius puberulum; stylus 9·5 mm. longus, basi puberulus.

Mê Mǎw, 300 m., climbing perennial in deciduous jungle, *Kerr* 3632.

Celtis (**Solenostigma**) **Collinsae,** *Craib* [Urticaceae-Celtideae]; a *C. philippinense*, Blanco et *C. strychnoide*, Planchon, nervis lateralibus basalibus foliorum apices haud attingentibus, nervis lateralibus superioribus e costa ortis subtus prominentibus facile distinguenda.

Arbor parva; ramuli juventute puberuli, sicco plus minusve fuscescentes, demum glabri, cinereo-corticati. *Folia* oblongo-ovata vel elliptico-ovata, apice acuminata, summo apice obtusa, breviter apiculata, basi saepe inaequilateralia, cuneata, rotundato-cuneata vel maiora rotundata, usque ad 8 cm. longa et 5·4 cm. lata, coriacea, primo subtus ad nervos sparse subsericea et supra marginem versus et basi puberula, demum glabra, e basi trinervia, nervis duobus lateralibus foliorum apices haud attingentibus cum

costa supra conspicuis subtus valde prominentibus, nervis e costa ortis patulis vel fere patulis subtus prominentibus intra marginem anastomosantibus, margine integra, recurva; petioli circa 1 cm. longi, supra canaliculati, primo puberuli, demum glabri vel fere glabri; stipulae fugaces, 4 mm. longae, basi productae, dorso puberulae. *Cymae* axillares, foliis multo breviores, ramulis puberulis, floribus fere sessilibus. *Fl.* ♂. *Sepala* 5, obovata, 1·5 mm. longa, vix 1·5 mm. lata, membranacea, ciliata. *Disci* glandulae parvae. *Stamina* sepalis opposita, filamentis glabris sepalis subaequilongis; antherae vix 1 mm. longae, apice saepius breviter apiculatae. *Ovarii* rudimentum parvum, columnare, glabrum.

Sriracha, on bank above rocks and beach, *Mrs. D. J. Collins*, 230, 241—the latter with deformed flowers.

Gironniera longifolia, *Craib* [Urticaceae-Celtideae]; a *G. subaequali*, Pl., foliis longioribus tenuioribus parte superiore serratis recedit.

Arbor 12-15-metralis (ex *Kerr*); ramuli juventute brunnei vel fusco-brunnei, dein pallide corticati, primo pilis longis rigidis pallidis tumidis copiose instructi, mox glabri. *Folia* oblongo-elliptica vel lanceolato-elliptica, apice acute caudato-acuminata, basi cuneata vel late cuneata, saepe inaequilateralia, usque ad 26·5 cm. longa et 9·7 cm. lata, rigide chartacea, pagina superiore ad costam sparse et inferiore ad costam nervosque laterales densius pilis iis ramulorum similibus instructa praetereaque subtus setulis sparsis ad nervulos aspera, nervis lateralibus utrinque 9-12 intra marginem anastomosantibus supra conspicuis subtus prominentibus, nervulis rete conspicuum subtus efficientibus, parte saltem triente basali excepta serrata vel serrato-dentata, petiolo circa 6-10 mm. longo supra canaliculato indumento ei ramulorum simili tecto suffulta; stipulae cito deciduae, circa 1·5 cm. longae, dorso margine pallido lato excepto pilis et longis et brevibus rigidis pallidis tectae, intra glabrae. *Inflorescentiae* axillares et ♂ et ♀ e basi ramosae. *Fl.* ♂ breviter pedicellati, 5-meri. *Sepala* quoad formam variabilia, saepius obovata oblongae, apice rotundata, circa 1·75 mm. longa et 1·3 mm. lata, ciliolata, dorso setulis perpaucis instructa, basi incrassata. *Filamenta* 1·75 mm. longa, glabra; antherae superne attenuatae, 1·5 mm. longae, apice et lateribus setulosae. *Ovarii* rudimentum breve, villosum. *Fl.* ♀ plerumque distincte pedicellati, rarius subsessiles. *Sepala* iis maris similia sed paululo maiora. *Ovarium* circa 5 mm. altum, adpresse albo- vel brunneo- setulosum; styli rami 2, circa 1·5 cm. longi. *Fructus* drupaceus, ambitu ovatus vel orbiculari-ovatus, compressus, 8-9 mm. longus, sparse adpresse setulosus.—? *G. subaequalis*, Pl., var. *birmanica*, Hook. f., Fl. Brit. Ind., v. p. 486.

Doi Wao, 900 m., in evergreen jungle, *Kerr* 2439 (♀), 2439 A (♂).

Probably referable to this species is *Toppin* 4061 from Upper Burma.

XXXVI.—MISCELLANEOUS NOTES.

Letter from the Minister of the Belgian Colonies.—The following letter from the Minister of the Colonies, Belgium, has been received by the Director:—

Royaume de Belgique,
Ministère des Colonies,
Londres, le 10 décembre, 1918.

Monsieur le Directeur,

Les services du Ministère des Colonies qui, pendant près de quatre ans ont fonctionné à Londres, rentrent à Bruxelles vers la fin de cette semaine.

Je ne veux pas quitter le Royaume Uni sans vous exprimer ma vive gratitude pour l'assistance particulièrement aimable que vous avez daigné accorder aux fonctionnaires de mon département.

Les rapports qui ont existé entre votre établissement et le Ministère des Colonies ont toujours été empreints de la plus grande cordialité, et je tiens spécialement à rendre hommage à la courtoisie dont vous n'avez cessé de faire preuve à l'égard de mes délégués qui se sont permis de faire appel à votre haute compétence.

Je vous saurai gré de bien vouloir remercier les fonctionnaires sous vos ordres qui se sont montrés toujours très empressés à assister mon personnel.

Je vous prie d'agréer, Monsieur le Directeur, l'assurance de ma considération la plus distinguée.

Presentations to Museums.—The following miscellaneous specimens have been received in addition to those previously recorded in the *Bulletin*:—

Superintendent, Botanic and Forestry Department, Hong Kong.—Seeds of *Strychnos angustiflora*, *Strychnos paniculata*, and of *Momordica cochinchinensis*.

Mr. S. T. Heard, Tahilla, Co. Kerry.—Portion of stem of *Cordyline australis*.

Mr. I. B. Pole Evans, Department of Agriculture, Pretoria.—Barks of *Erythrophloeum guineense*, and of *Croton* sp.

Lt.-Col. E. R. Wayland.—Sample of Linseed from Japan.

Sir Archibald Buchan-Hepburn, Bart., Prestonkirk, N.B.—Plank of *Abies amabilis*.

Messrs. Ide and Christie, Crutched Friars, London, E.C.—Fibre from *Hypoxis rigidula*, South Africa.

Sir John Brunner, Bart., Silverlands, Chertsey.—Plank of *Sequoia gigantea*.

Mr. R. T. Gunther, Magdalen College, Oxford.—Section of a large Elm from the grounds of the College.

Miss A. E. Beasley, Park Road, Teddington.—Fruit of *Strychnos spinosa*, B.E. Africa.

Mr. N. Gosling, Chaco, Paraguay.—Seeds of *Ilex Paraguayensis*.

Lady Blake.—Section of wood of *Cecropia peltata*, Jamaica.

Lieut.-Col. W. Dixon, The Castle, St. Helena.—Fibre and tow extracted from plants of *Alpinia nutans*.

Sir Edmund G. Loder, Bart., Leonardslee, Horsham.—Upright growing stem of *Arctostaphylos media* and grafted stem of a Rhododendron.

Director, Botanic Gardens, Singapore.—Specimens of wood of *Ormosia macrodisca*, *Castilloa elastica*, and *Diospyros bilocularis*.

Mr. A. E. Pratt, Kingston Road, Teddington.—Photograph of *Myrmedoma arfakiana*, New Guinea.

Mr. A. C. Miles, Senior Curator, Agricultural Department, Gold Coast.—Photograph of the Royal Palm Avenue, Tarkwa, also fruits of Broke-back (*Chailletia toxicaria*).

Capt. H. T. Last, London, W.C.—Sample of rope made by the Germans from the inner bark of the Lime (*Tilia vulgaris*), for hauling heavy minenwerfer.

Messrs. Farrell and Co., Caledonian Road, London, N.—A complete set of material to illustrate the manufacture of the English violin, violoncello, and bow. Placed in Museum No. IV.

The Earl of Eldon.—Branch with cones of *Cupressuus macrocarpa* var. *lutea*, from Encombe, Corfe Castle, Dorset.

Curator, Botanic Garden, Dominica.—Seeds of the Shea butter tree (*Butyrospermum Parkii*), grown in the Botanic Garden, Dominica.

Curator, Agricultural Department, Old Calabar.—Sample of hand-made twine from fibre of *Agave sisalana*, grown in the Economic Gardens, Old Calabar.

Messrs. Wigglesworth and Co., Fenchurch Street, London, E.C.—Samples of fibre from *Cannabis sativa*, Wisconsin; *Furcraea Cabuya*, *integra*, Costa Rica; *Furcraea macrophylla*, Peru; and *Furcraea* sp., Colombia.

Mr. M. T. Dawe, San Lorenzo, Colombia.—Seeds of Ortoba (*Myristica Otoba*). A fatty oil extracted from the seeds is highly valued in Colombia for application in certain skin diseases of animals, also for the treatment of ticks in cattle. J. M. H.

"Kyov" or "Kev" plant of Kashmir.—A few months ago Sir George Grierson wrote to Kew as follows.—"There is a plant growing in Kashmir called 'kyov' or 'kev,' which native authorities say grows in marshy ground, and has globular roots (? like a potato tuber). Lawrence ("Valley of Kashmir," p. 72) says it is *Chaerophyllum* sp., and is looked upon as an excellent substitute for carrots. Native authorities add that its uprooting is a long, slow business, and hence 'to root up kyov' is used as a metaphor for 'spending a long time over the completion of anything.' . . . . There is a compound word *kevi-rath*, which native authorities say is 'the creeper of this plant,' *i.e.*, 'an underground fibrous network over a wide area and connecting the roots of this plant.' This, as nearly as I can get it, is a translation of the Sanskrit account sent to me, and I should be most grateful if you could kindly tell me if it is correct, or what

is meant by the 'network' ('jal')." A dried specimen of the plant was eventually obtained for Sir George by Dr. E. Neve, of the Mission Hospital, Srinagar, who writes: "It is possible that the name 'kev' may be used for the different plants, one in the mountains, a *Chaerophyllum*, mentioned by Lawrence. But what is known as 'kev' here in Srinagar is a marsh plant with jointed spreading succulent roots which form a tangled mass called *kevi-rath*. I believe the word *rath* is also used for the tangled roots of potatoes. The word *Jala* in this connection doubtless means 'net'."

The plant forwarded by Dr. Neve is *Sagittaria sagittifolia*, L., (*Alismaceae*), a common aquatic herb in Europe and Asia and throughout North America. According to Watt (Dict. Econ. Prod. Ind., vi. ii. 383), the species is common on the borders of fresh-water lakes, tanks, and ditches throughout India. He remarks that the natives of India are apparently ignorant of its value as a food plant. Smith (Chinese Materia Medica, 189) says that *S. sinensis*, Sims. (=*S. sagittifolia*) is cultivated in some parts of China for the sake of its edible "rhizome" (tubers). This is confirmed by Hance, who writes on his label accompanying a specimen that it is cultivated near Canton for the same purpose. The tubers terminate stolons distinct from the fibrous roots something after the manner of a potato. J. H.

Ranunculus nissanus.—This Serbian species was described by Capt. Petrovič in his Additamenta ad Floram Agri Nyssani, p. 21 (1885). The name is wrongly referred by *Ind. Kew.* Suppl. ii. (1904), to Max Leichtlin, as follows:—"*Ranunculus nyssanus*, Leichtl., in The Garden, lv. (1899), 418, Quid?," probably in reliance on *Kew Bull.* 1900, App. ii. p. 49, where *R. nyssanus* is mentioned under 'New Garden Plants of the year 1899' without an author's name, though with reference to The Garden loc. cit. But what Leichtlin there says is merely that *R. nyssanus* was in beauty in his garden at the moment of writing. He gives no description nor does he name the real author of the species.

Nicholson, Dict. Gard. Century Suppl., p. 632 (1901), repeats the misspelling *nyssanus*, and K. Schum., in Just, Jahresb. xxvii. i. 506, twists it into *nyssänus*! It is odd that Petrovič should have adopted the spelling *Nyssanus* for the title of his book, but *nissanus* for that of his species. As his description is in Serbian the Latin translation offered below may be useful. The Kew library has a copy of the book, and the herbarium a specimen of the plant from Herb. Churchill, labelled "F. Schultz, Herb. Norm. nov. ser. cent. 18, no. 1706. *R. psilostachys*, Griseb. Majo 1883. Ad margines pratorum circa oppidum Nisch, Serbia. Leg. Dr. S. Petrovič," to which Mr. Churchill has annotated, "from Dr. Keck's notes to Cent. 20 and 21 of F. Schultz's Herb. Norm., the plants are not *R. psilostachys*, Griseb., but instead *R. nissanus*, Petrovich."

In the absence of fruits and stolons, characters on which Petrovič relies, I can offer no opinion as to the distinctness of *R. nissanus* from *R. psilostachys*, Griseb., on the one hand and from *R. Tenorii*, Jord., on the other.

Ranunculus nissanus.—Fibrae radicales incrassatae, cylindricae, oblongae, ovoideae, subrotundaeve, prout progressione sua augescunt (according to their stage of development).

Caulis par subterranea stolones subterraneos tenuissimos filiformes, foliis grumisve crassiusculis subrotundis terminatos edens. *Folia radicalia primordialia* autumno aut primo vere edita, postea evanida, ambitu suborbicularia, dentibus 9-10, vel etiam pluribus, latis obtusis leviter insculpta, petiolo brevi suffulta, viridia, pilis sparse vestita. *Folia radicalia seriora* vernalia, albescentia, pilis sericeis adpressis vestita, longe petiolata, usque ad basin in segmenta obovato-cuneata tria divisa, segmento intermedio in lacinias 3-4 integras inaequaliterve dentatas partito, lateralibus fere usque ad medium bilobis, lobis inaequaliter tridentatis. *Folia caulina* breviter petiolata, in segmenta tria integra lobatave partita. *Folia superiora* fere sessilia, in segmenta tria oblonga integra partita. *Caules* cylindrici, pilis furcatis albis sericeis vestiti, superne parum ramosi, ramo saepius unico, rarius ramis duobus tribusve approximatis. *Flores* flavi, lucidi, insignes. *Sepala* 5, oblongo-ovata, externe pilosa, demum reflexa. *Petala* rotundiuscule obovata, sepalis longiora, prope basin nectario squama conspicua operto munita. *Carpella* lateraliter compressa, ovoidea, in rostrum apice uncinatum desinentia, secus spicam cylindricam longiusculum ordinatim disposita.

Serbia.—Dry slopes and by roadsides below Mount Gabrovatz, below the fortress of Kurin, near Nish, opposite Medoshevatz, and near Mramor. Flowering in April and May.

It was described in the Flora Agri Nyssani as *R. psilostachys*, Griseb., but differs therefrom in its less deeply-cut earliest radical leaves, in its caudate carpels, in their beaks, and in its subterranean stolons.

The nearest ally to the Nish plant is *R. cylindricus*, Jord., but this also is very different, owing to its dissected earliest leaves.

C. C. LACAITA.

South African Fever Bark.—We are indebted to the kindness of Professor H. G. Greenish for the following note embodying the results of an examination in the Research Laboratories of the Pharmaceutical Society of Great Britain of the bark of *Croton Gubouga*, S. Moore, the botanical identity of which was discussed on an earlier page (*K.B.*, 1918, p. 243). The note has already been published in the Pharmaceutical Journal, Dec. 14, 1918, p. 289.

In an address delivered before the Cape Town Medical Society in 1899 by John Maberley, M.R.C.S., L.R.C.P., the following account is given of a bark used as a remedy for bilious malarial fever by the natives of the low veld between Delagoa Bay and the Letaba Gold Fields:—

"Then there is another drug—one which before this day has never seen the light. This is represented, unfortunately, by no more than a small piece of bark which I exhibit, and which

has a somewhat peculiar history. When I was in charge of the Klein Letaba Gold Fields Hospital in Central Transvaal—one of the very worst districts for malarial bilious fever in South Africa—I had some beans belonging to this same tree given to me which came from a man who had obtained them when travelling through the low veld from Delagoa Bay to the gold fields. The man's story of the beans was interesting. He was an old prospector, accustomed to low country fever, and he stated that when he was passing through the Lebombo Flats he had a violent attack of bilious fever and was laid up at a Kaffir kraal. He had a couple of valuable greyhounds with him which were much noticed by an old Kaffir doctor who came along, and who promised to cure the patient of his fever if he would part with the dogs. The man, who had suffered from similar attacks before, would not agree to this, and stated that he could cure himself. However, getting worse and losing faith in the prospect of his recovery, he sent for the Kaffir doctor and promised him the dogs as a reward for a cure. The old fellow administered some of the beans, with the result that in a couple of days the man was about virtually cured. He got some of the beans from the Kaffir doctor, and a few of them came into my possession. I subjected them to a fair trial. We had 200 white men in the mines, and, as illustrating the unhealthiness of the climate, I might say that during February, March, and April, the workmen just put in one-third of their time. The remainder they took out in fever. After trying the beans and bark I came to the conclusion that a dose of two grains was quite sufficient. This dose, made into a pill with a quarter of a grain of opium, I always rely on to cut short relapses of malarial fever both in my own person and those of my patients. The peculiar action of the drug lay in the fact that it had a most extraordinary power of collecting bile, and if the attack was at all well marked in half an hour the patient not only passed a lot of bile but also vomited a large quantity from the stomach. That, I am certain, is a particularly valuable drug, but I cannot trace it further. I got a few of the beans, and out of six or eight which I planted I obtained one plant. Unfortunately, having to go away, I found on my return that the plant had been destroyed by hail. Afterwards a white man sent me some pieces of bark and a few beans, but they were incapable of germination. Then I tried again, and found that Kaffirs had been told by a native doctor that the trees, which were growing in a mealie field, were bewitched, and had better, therefore, be destroyed. This was done, with the result of a further disappointment. It was a pity that it could not be traced, for it would be a very valuable remedy for the types of fever we get in southern tropical Africa. I have tried in London to analyse the bark with the assistance of a good chemist, but we could make nothing of it."*

A small quantity of this bark was sent to the Royal Botanic Gardens, Kew, and a part was forwarded to me with the request that I would investigate it as far as possible, the botanical examination having been undertaken at Kew. The investiga-

* *Lancet*, 1899, p. 873.

tion was carried out in the Pharmacy Research Laboratory, with the following results:—

The sample consisted of about 150 grammes of the bark and a tin containing about 17 grammes of the powder. The bark was in pieces about 5 to 10 centimetres long, 3 centimetres wide, and 2 to 3 millimetres thick. Externally the younger pieces exhibit alternating longitudinal bands of dark grey and paler grey thin cork; in the older pieces greyish warts occur which eventually become very numerous. The inner surface is pale grey. The transverse section is pale yellow grey, and shows under the lens a thin dark cork and numerous whitish secondary medullary rays. No odour; taste at first slight, slowly followed by a persistent acridity. Under the microscope the bark is characterised by the abundance of sclerenchymatous cells and of calcium oxalate, the latter being in prismatic or in cluster crystals. The medullary rays are one or two cells wide, and most of the cells contain a cluster crystal of calcium oxalate. In section the sclerenchymatous cells differ but little in size or shape from the parenchymatous cells; they are arranged in irregular masses throughout the secondary bast. Not unfrequently the cavity of the cell is filled with a prismatic or cluster crystal of oxalate. Associated with the sclerenchymatous cells are bast fibres, singly or in groups; they are strongly thickened and distinctly striated. In the parenchymatous cells oil globules occur, and also a few minute starch grains. A longitudinal section, stained with phloroglucin and hydrochloric acid, exhibits elongated cells filled with a yellowish, granular secretion; the inner lamella of the walls of the cells is suberised and lignified. These characters agree with those of Croton barks.

The powder accompanying the sample of bark was examined, and found to be derived from the bark.

Twenty grammes of the powdered bark were exhausted in a Soxhlet with petroleum spirit, ether, chloroform, and alcohol (97 per cent.) in succession. The petroleum spirit removed 2·54 per cent. of a fatty substance which possessed in a high degree the characteristic taste of the bark. Ether extracted a further 0·49 per cent. which had a much less acrid taste. The chloroformic extract amounted to 0·53 per cent., and was free from acridity. Alcohol removed 2·71 per cent., which was also acrid. All these extracts were tested for alkaloids, but in no case was any indication of the presence of one obtained.

To ascertain whether the acrid principle could be separated by steam distillation 10 grammes of the bark were steam distilled, the distillate shaken out with petroleum spirit, and the petroleum spirit solution evaporated to dryness; the residue was practically tasteless. The contents of the flask were then mixed with an equal volume of alcohol, boiled for a short time, filtered, and the alcohol removed by distillation under reduced pressure. The residual turbid liquid contained the acrid principle. It was shaken with petroleum spirit, ether, and chloroform in succession. Petroleum spirit removed nearly the whole of the acrid principle, ether a further small quantity, and chloroform none. It is therefore not volatile in steam.

As the acid principle was soluble in alcohol of about 50 per cent. strength, 100 grammes of the bark were exhausted by three successive macerations with alcohol of this strength. The mixed filtrates were shaken with petroleum spirit, which removed fatty matter, freed from alcohol by distillation under reduced pressure, and the resulting turbid liquid repeatedly shaken out with petroleum spirit. The petroleum spirit solution, evaporated to dryness at a low temperature, left a small quantity of a pale yellowish viscous residue. This was dissolved in 15 c.c. of alcohol, the solution diluted with an equal volume of water, and the acrid principle again extracted with petroleum spirit and finally with ether. The mixed solutions, evaporated to dryness, left 0·239 gramme of a brownish-yellow viscous oil, which rapidly darkened on heating to 100 deg. The quantity was too small to allow of further attempts at purification.

A minute quantity of this substance placed on the tongue produced the characteristic partially numbing taste of the bark, which was extremely persistent, lasting in some instances for nearly 24 hours. A tincture of the bark made with 50 per cent. alcohol had a similar taste, and also produced, when applied to the skin, a persistent redness and irritation.

The active principle of the bark appears, therefore, to be an acrid viscous oil, or soft resin.

Acrid principles of this nature are, as is well known, widely spread in the genus *Euphorbia*, of the natural order *Euphorbiaceae*, and are also found in croton oil and the milky juice of the manchineal. Most members of the genus *Croton*, however, contain, as far as is known, bitter principles (*C. Eleuteria*, *C. niveus*) or alkaloids that have not yet been sufficiently examined.

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